THE DENTAL PRACTITIONER

AND DENTAL RECORD

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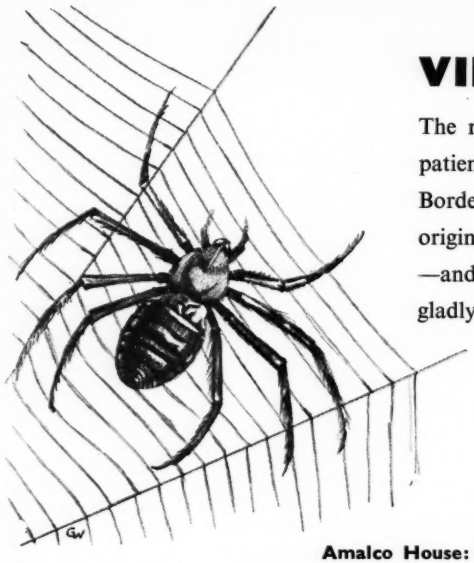

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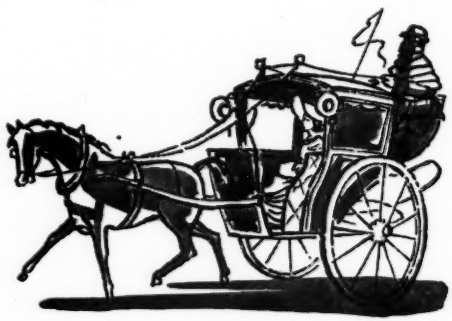

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THE DENTAL PRACTITIONER AND DENTAL RECORD

Vol. X, No. 4 December, 1959

EDITORIAL

TEACHING PREVENTIVE DENTISTRY

Teeth get a raw deal. They form and erupt in childhood and, from that moment on, are used constantly day after day with but cursory care by the average citizen. Teeth are taken for granted until that moment when they start aching. By that time, as every dental practitioner knows, the rot so often has set in too deep and the tooth (or teeth) must come out.

It is customary, alas, for the patient to welcome the extraction. "The sooner I get a set of false ones the happier I'll be" is still the anachronistic cry of a patient who, with a little care a little sooner, need not have lost a tooth for years, if ever.

Is it not time, therefore, that more positive action was taken in this country towards creating a "dental conscience"?

How can the elements of dental health be best taught the layman?

The Dental Practitioner considers this education to be three-pronged. Juveniles and adolescents should receive a sound basic instruction in oral hygiene, the adult layman should be approached, and so should the general medical profession. How? The Editor would like to make the following observations.

In the case of young people there would seem to be a strong case for more intensive instruction at school. Since the under-twenties possess teeth which could last them fifty years, the importance of their treating them decently cannot be over-stressed. Parents have too little knowledge themselves to be valuable; dental practitioners have too little time. Teachers, however, could well receive first-class instruction to be passed on to their pupils. The customary Personal Hygiene class now given in most schools would be the time and place.

Adult education is harder because the adult is less receptive to "being told". He needs the application of the hidden persuaders. The television programme "Emergency—Ward 10" is the perfect hidden persuader in action. It is a striking example of brilliantly entertaining scriptwork allied to responsible medical information. Women's magazines are also invaluable, as is the radio. The layman likes his information presented in palatable form. Why not? And why cannot we make more imaginative use of the entertainment mediums open?

In conclusion, we have the general medical profession who already appreciate the value of all this. But it is basically outside their orbit. Could not more direct education on preventive dentistry be given to doctors and nurses? Taught in the medical schools and hospitals, it could also be followed up periodically in the medical press.

THE RELATIONSHIP OF AMALGAM TO THE CAVITY WALL

By **S. D. HATT**, B.D.S. (St. And.), M.D.S. (Manc.), F.D.S. R.C.S. (Edin.)
Turner Dental School, Manchester

INTRODUCTION

A REVIEW of the literature has shown that there is lack of uniform thought regarding certain procedures carried out in amalgam manipulation. These are:—

1. The amount of mercury to be expelled from the recently triturated amalgam.
2. The condensation technique.

This is confirmed by the American Dental Association (1958), the British Standards Institution (1957), and the Fédération Dentaire Internationale (1957), whose specifications on alloys for dental amalgam offer no specific guidance on these procedures.

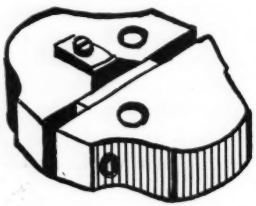


Fig. 1.—The assembled die, showing the glass matrix and the ejector.

Variations of these procedures, it is postulated, might have a possible influence upon the nature of the relationship of amalgam to the cavity wall. Moreover, it is the quality of this relationship which determines in large measure whether caries will or will not recur in the restored tooth.

This investigation is therefore designed to assess the relationship of an amalgam restoration to the cavity wall as influenced by:—

1. The amount of mercury expelled immediately after trituration and prior to condensation.
2. The condensation method.
3. The condensation pressure.

In all other respects the manipulation procedures were carried out in accordance with the alloy manufacturers' instructions.

MATERIALS

Since the results of faulty adaptation of amalgam become so frequently apparent at the cavo-surface of the proximal portion of Class II cavities, where relatively minor inadequacies may cause the failure of the restoration, it was felt this region merited special attention if subsequently any observations were to have real clinical application. Moreover, amalgam having a relatively low resistance to sheering stress, the cavo-surface

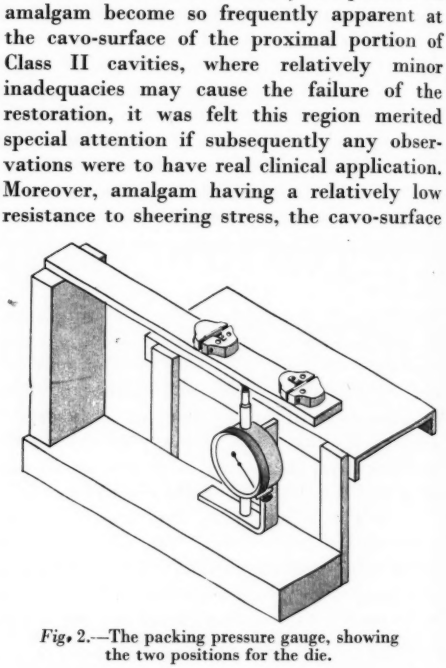


Fig. 2.—The packing pressure gauge, showing the two positions for the die.

angle is never bevelled but is so designed to provide a butt joint between the restoration and the cavity margin. The necessity to extend the cavity margins into the proximal embrasures and the need to finish the buccal and lingual walls parallel to the long axes of the enamel rods generally result in these walls meeting the encircling matrix band at an angle of approximately 80°.

For purposes of the investigation, therefore, an artificial cavity closely resembling in these particulars the proximal portion of a Class II cavity was prepared in steel.

This was accomplished by cutting through the diameter of a one-inch circular steel

casting measuring $\frac{1}{4}$ in. in thickness. The cut surface of one half was then slotted in such a manner as to form the proximal portion of a Class II cavity measuring 4 mm. from buccal to lingual margins, 5 mm. from the occlusal surface to the gingival wall, and 2·5 mm. from the gingival margin to the axial wall, with parallel buccal and lingual walls to allow ready access, a flat gingival floor, and axiolingual and axiobuccal line angles of 100°, so that the lingual and buccal walls met the matrix at approximately 80°.

A smooth sheet of glass, when clamped between the two halves of the steel casting, functioned as a matrix to the cavity, into the axial wall of which a small ejector was fitted, which facilitated the removal of the set amalgam (*Fig.* 1).

On the under surface of the die two holes were drilled to allow accurate positioning of the die on to the packing pressure gauge which was calibrated in pounds pressure for both positions of the die, the maximum deflection required in the experiments being 0·007 in. A hand rest was attached to the platform and was so designed as to allow the hand to be placed close to the artificial cavity in whichever position the die was placed (*Fig.* 2).

METHOD

The specimens were prepared by condensing amalgam into the die set up on the pressure gauge.

Manipulation of the Amalgam.—The alloy used throughout the investigation was New True Dentalloy. The ratio of 5 parts of alloy to 7 of mercury, as recommended by the manufacturers, was adhered to, and 0·714 g. of alloy and 1 g. of mercury (weighed on an analytical balance to the nearest milligram) were the quantities utilized for each test. These amounts are similar to those normally used for an average Class II restoration.

Following the manufacturers' instructions, the materials were then amalgamated in a S. S. White amalgamator for a period of 17 seconds.

The removal from the amalgamated mass of determined quantities of mercury was then standardized by utilizing a "G" clamp suitably calibrated with a dial gauge (*Fig.* 3). The collection and subsequent weighing of the mercury so removed provided an accurate check on this procedure.

The quantities of mercury removed were 15, 20, 25, 30, and 35 per cent of the original amount used in the amalgamation procedure. As soon as the mercury had been expelled the resultant pancake of amalgam was ejected from the clamp and the die filled. The amalgam was carried to the die in increments of 0·24 g. using an amalgam carrier.

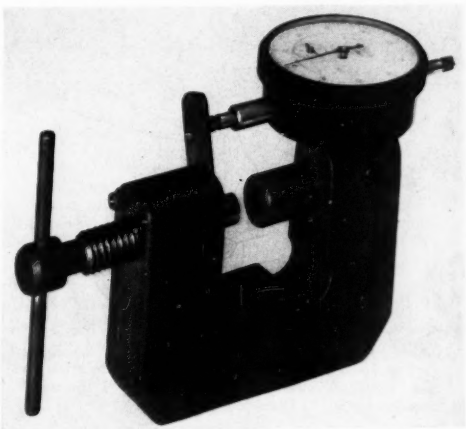


Fig. 3.—The "G" clamp fitted with a dial gauge.

Condensation was carried out by two methods:—

1. Hand condensation.
2. Mechanical condensation.

(Both condensers were the largest commercially available of their type which could conveniently gain access to the cavity.)

1. *Hand Condensation.*—This was carried out with two condenser points. Hand condenser No. I was a flat serrated packer, circular in outline, having a diameter of 0·06 in. and an area of 0·0028 sq. in.

Hand condenser No. II was a flat packer, trapezoidal in outline, having an area of 0·0036 sq. in. Both condensers are shown relative to the artificial cavity in *Fig.* 4.

2. *Mechanical Condensation.*—One of the most universally accepted instruments of this type now in use is the Swedish Dentatus. This

instrument is similar in contour to a contra-angled handpiece, and fits the slip joint of a dental engine. A series of different shaped packer points can be fitted. In this investigation a flat point, circular in outline, was used, having the same area as the point used in condenser No. I.

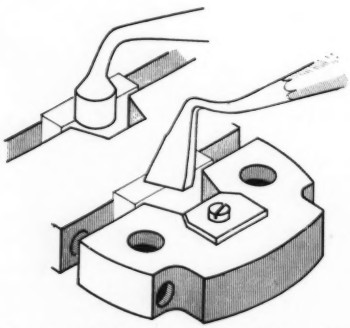


Fig. 4.—The hand condensers shown in relation to the artificial cavity: condenser No. I (*above*); condenser No. II (*below*).

The point is loosely held in a chuck and as soon as light pressure is applied to the end it is forced against a four-sided rotating rod which

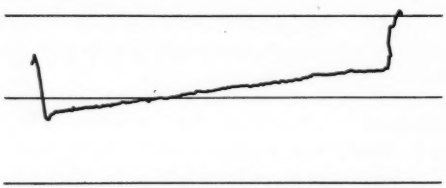


Fig. 6.—Talysurf tracing of the glass matrix. Vertical magnification × 8500; horizontal magnification × 21.

causes it to vibrate. The number of vibrations per minute can therefore be varied according to the engine speed, there being four strokes of the point to every revolution of the engine. In this investigation an engine speed of 5000 r.p.m. was used, thus giving 20,000 vibrations per minute. The pressure exerted on the instrument was ½ lb. Any excess pressure placed the instrument under a strain. Care was taken throughout the condensation procedures to remove the layer of mercury-rich amalgam which came to the surface. This was carried out immediately each increment was completely condensed, and was accomplished by using a sharp discoid excavator as is done in clinical practice.

Each specimen was allowed to set for 20 hr. before the die was opened, the glass removed, and the specimen withdrawn by means of the

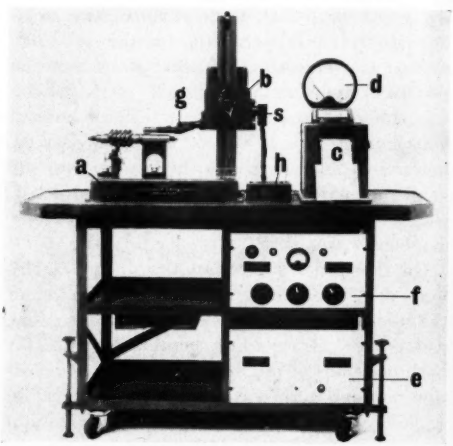


Fig. 5.—The Talysurf. (*By courtesy of Taylor, Taylor & Hobson Ltd., Leicester*)

ejector, thus ensuring that the surface of the specimen, which was packed against the glass, was undisturbed. This surface was then analysed using the Talysurf surface analyser.

The Talysurf.—Workshop instruments for measuring surface finish are an innovation of the last few years, for the accurate measurement of surface finish has only been carried out in the laboratory for the last 25 years. The most satisfactory method, not involving the destruction of the specimen, that has so far been found, is known as the stylus or tracer method. In the Talysurf a sharply pointed stylus traverses the surface by means of a motorized unit. The up-and-down movements of the stylus are converted into a correspondingly varying current which is amplified and then applied to measuring instruments providing:—

1. A graph drawn on paper representing the shape of the cross-section of the surface roughness.

2. A number shown by a scale and pointed representing the average roughness of the surface.

A very wide range of magnification can be provided. In the vertical direction the self-contained range is from 2000 to 40,000, but by means of accessories the range can be extended down to 400 and up to 100,000. In the horizontal direction the normal magnification is 200, but a magnification of 50 can also be secured.

An assembled instrument is shown in *Fig.* 5. The principal units forming the basic instrument are mounted on a trolley, and comprise the stand **a** and gear box **b**, the pen recorder **c**, the average meter **d**, power unit **e**, and

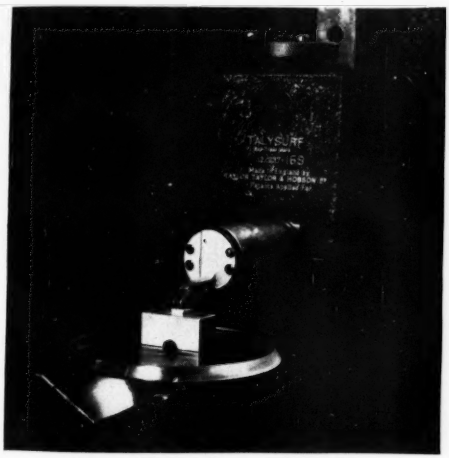


Fig. 7.—The amalgam specimen set up relative to the Talysurf stylus.

amplifier **f**. With the basic unit must be used a suitable type of pick-up **g**, together with its control unit **h**.

The Talysurf recording of the glass section used in the die is shown in *Fig.* 6. The original magnification in the vertical direction was 20,000, and in the horizontal direction it was 50. The tracing confirms the fact that the glass section is smooth, and for the purpose of this investigation it can be taken to be a straight line. It follows, therefore, that the nearer the trace of the specimen is to a straight line the closer is the proximity of the amalgam to the cavity wall. In all cases the traces were taken by positioning the specimen relative to the stylus, as shown in *Fig.* 7.

Two traces were made of each specimen along the lines 1 and 2 (*Fig.* 8). These gave an accurate reproduction of the surface characteristics of each specimen. The trace along line 1

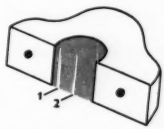


Fig. 8.—A diagram showing the lines on the amalgam specimen along which the traces were made. Traces taken along line 1 represent the surface characteristics of the specimen near the cavo-surface angle, and those along line 2 the surface characteristics against the cavity wall.

represents the surface characteristics of the amalgam near the cavo-surface angle of the "cavity", and along line 2 the characteristics of the specimen against the wall of the "cavity".

All traces were interpreted by using a modification of the peak to valley (P.V.A.) average heights. The sampling length chosen was 0·01 in., and the average of five such lengths was taken to represent an assessment of the surface texture (British Standards Institution, 1950). The P.V.A. is represented by a figure in micro-inches. Thus, a straight line will have a P.V.A. of zero, and so the nearer the P.V.A. of the specimen is to zero, the closer the adaptation of that specimen to the cavity wall.

Analysis of Residual Mercury.—In order to avoid the possibility of obtaining results which would have had no clinical significance, i.e., good adaptive qualities at the expense of all the other attributes an amalgam should possess, a further series of tests was carried out.

In view of the finding of Swartz and Phillips (1956), who stated that the crushing strength of amalgam was inversely proportional to the residual mercury content, an analysis of the residual mercury content was carried out on a representative selection of all the specimens. Crushing strength tests could not be made on the specimens, as an accurate calculation of their dimensions would not have been possible.

The apparatus used for determining the residual mercury content is similar to that described by Crawford and Larson (1953), in which amalgam fillings are heated to 550° C. in an atmosphere of nitrogen to volatilize the mercury, avoiding at the same time the oxidation of the other constituents.

EXPERIMENTS

1. Hand Condenser No. I.—In this experiment 156 specimens were packed with condenser No. I. Twenty thrusts of the condenser were applied to each increment, the amalgam being carefully packed against the base into the line and point angles, and against the walls of the cavity. Pressures of 2, 4, 6, 8, 10, and 12 lb. were used, the same pressure being used for the completion of each specimen. *Table I* shows the relationship of lb. pressure to lb. per sq. in. for condensers No. I and No. II.

Table I.—The Relationship of Pressure in Lb. to Lb. per Sq. In. for Hand Condensers I and II

Pressure in Lb.	Lb. per Sq. In.	
	Condenser No. I	Condenser No. II
2	700	550
4	1400	1100
6	2100	1650
8	2800	2200
10	3500	2750
12	4200	3300

Table II shows the average P.V.A. values for all the specimens in micro-inches as calculated from the Talysurf traces, and *Fig.* 9 is the appropriate graph. Samples of typical Talysurf traces and photographs of the specimens are shown in *Figs.* 10 and 11.

Interpretation of Results.—The lines of the lower half of the graph (*Fig.* 9) represent the P.V.A. values of the traces of the specimens along line 2 (*Fig.* 8), and those on the upper half the P.V.A. values of the traces along line 1 (*Fig.* 8).

The ideal condition to be attained is complete apposition of the amalgam to the cavity wall; this would be represented by P.V.A. values of zero for the traces of the specimen along lines 1 and 2.

From *Fig.* 9 it follows, therefore, that the amalgam from which 20 to 25 per cent of the original mercury had been removed, prior to condensation, produced the best results for each condensation pressure.

The optimum condensation pressure using this condenser was 2800 lb. per sq. in., which is equivalent to a pressure of 8 lb. The average sizes of the spaces between the amalgam specimen and the cavity wall (line 2) and along the cavo-surface angle (line 1) following the removal of 20 to 25 per cent of mercury and under a condensation pressure of 2800 lb. per sq. in. were 66 and 140 micro-inches respectively.

Table II.—The Average P.V.A. Values, in Micro-inches, for all Specimens condensed with Hand Condenser No. I

Pressure in Lb.	Percentage of Mercury expelled									
	15		20		25		30		35	
	Line 1*	Line 2*	Line 1*	Line 2*	Line 1*	Line 2*	Line 1*	Line 2*	Line 1*	Line 2*
2	217	120	193	119	239	143	231	116	206	186
4	180	94	171	104	163	115	203	108	165	110
6	152	82	140	73	183	80	186	95	153	93
8	141	77	143	63	137	70	160	79	183	75
10	178	75	141	50	153	52	175	83	171	66
12	260	74	161	40			230	59	186	79

* *See Fig.* 8.

2. Hand Condenser II.—In view of the results obtained in the previous experiment, in this series the amount of mercury removed

from the recently triturated amalgam was limited to 20 and 25 per cent of the original mercury content, and all specimens were condensed at 2800 lb. per sq. in. which, on this condenser, entailed a pressure of 10 lb. (*Table I*).

Eighteen specimens were made with hand condenser No. II and, as in the previous series, 20 thrusts of the condenser were applied to each increment.

Table III shows the P.V.A. values in micro-inches for each specimen as calculated from the Talysurf traces. *Fig.* 12 is a photograph of one of the specimens.

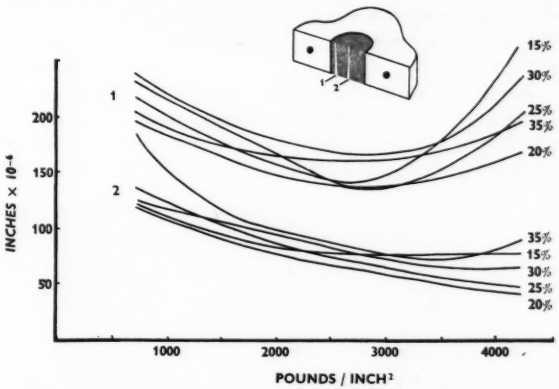


Fig. 9.—Graph showing the relationship between the condensation pressure (in lb./sq. in.) and the size of the spaces between the amalgam specimen and the cavity (in micro-inches). The figures on the right show the amount of mercury expelled prior to condensation.

Interpretation of Results.—These results show that a closer relationship of amalgam to the cavity was obtained by expelling 20 per cent of the original mercury. The average depth of the spaces between the amalgam and the cavity wall (line 2) was 61 micro-inches, which is a similar figure to that obtained with hand condenser No. I. However, the figure at the cavo-surface angle (line 1) was lower than that found in the previous series, and the average

Table III.—The P.V.A. Values, in Micro-inches, for all Specimens condensed with Hand Condenser No. II

Percentage of Mercury expelled			
20		25	
Line 1*	Line 2*	Line 1*	Line 2*
67	61	94	65
89	63	115	59
74	61	110	71
79	58	90	58
69	59	94	59
81	65	91	65
73	57	111	66
		108	71
		89	68
Average Values 76	61	100	66

* *See Fig.* 8.

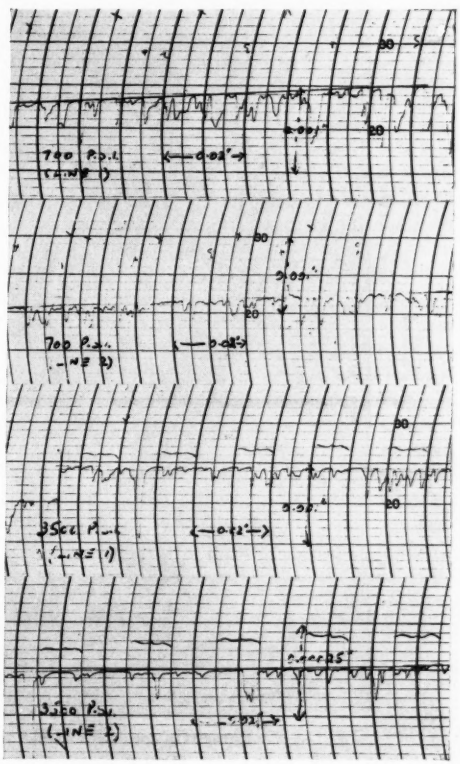


Fig. 10.—Talysurf traces of amalgam specimens.

depth of the spaces was only 76 micro-inches. These figures are superimposed on the graph (*Fig.* 13).

3. Mechanical Condensation.—Twenty specimens were made using the Dentatus vibrator fitted with a point having the same shape and area as hand condenser No. I.

Table IV shows the P.V.A. values, in micro-inches, of each specimen as calculated from the Talysurf traces. *Fig.* 14 is a sample of these traces and a photograph of one of the specimens.

Interpretation of Results.—The best results were obtained by expelling 25 to 30 per cent

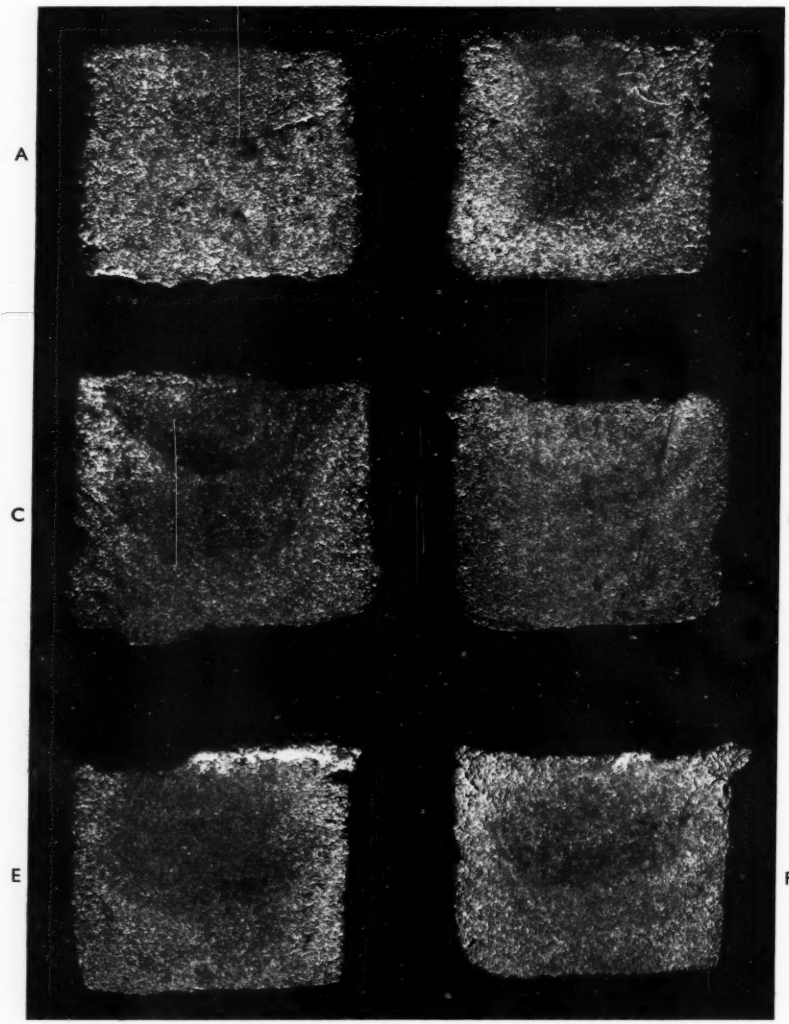


Fig. 11.—Photographs of specimens packed with hand condenser No. I. (× 6.) A, 700 p.s.i.; B, 1400 p.s.i.; C, 2100 p.s.i.; D, 2800 p.s.i.; E, 3500 p.s.i.; F, 4200 p.s.i.

of the original mercury from the recently triturated amalgam. The average depth of the spaces between the amalgam specimen and the cavity was considerably lower than in all the previous experiments. The figures for lines 1 and 2 were 38 and 25 micro-inches respectively. These figures are superimposed on *Fig.* 13.

Table IV.—The P.V.A. Values, in Micro-inches, for all Specimens condensed with the Dentatus

Percentage of Mercury expelled						
25		30		35		
Line 1*	Line 2*	Line 1*	Line 2*	Line 1*	Line 2*
30	22	46	26	65	42
36	19	49	30	68	48
32	25	43	31	61	40
26	18	49	26	59	41
28	27	39	25	70	47
30	24	38	27	72	50
				65	39
				66	39
Average Values 31	23	44	27	66	44

* *See Fig.* 8.

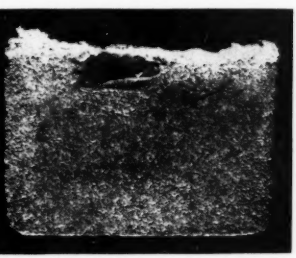


Fig. 12.—Photograph of a specimen packed with hand condenser No. II. (× 6.)

Residual Mercury Analysis.—The average amount of mercury in the specimens was as follows:—

Experiment 1 48·0 per cent.

(Specimens condensed at 2800 lb. per sq. in. after 20 to 25 per cent of mercury was expelled.)

Experiment 2 49·1 per cent.

Experiment 3 46·7 per cent.

The highest value recorded (52·8 per cent) occurred in the specimen condensed at 700 lb. per sq. in. after 15 per cent of the original mercury had been expelled.

DISCUSSION AND CONCLUSIONS

The results show that complete apposition of amalgam to the cavity wall cannot be achieved, irrespective of the technique adopted for the manipulation of the material. This substantiates the findings of Crawford and Larson (1956) and Wainwright, Taylor, Marlis, and Villanyi (1957), who stated that all the amalgam restorations they had examined exhibited micro-leakage.

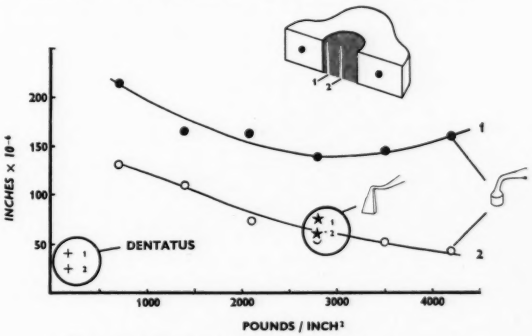
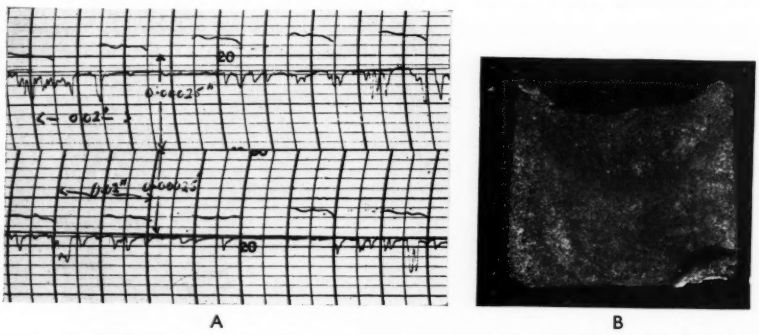


Fig. 13.—Graph showing relationship between the condensation method and the sizes of the spaces between the amalgam specimen and the cavity.

Considerable variation in the quality of the relationship of amalgam to the cavity wall has, however, been observed. This has varied according to the method of manipulation.

There is no evidence in the literature of any reports on the effect on adaptation of amalgam to the cavity wall of varying the amount of mercury expelled immediately following trituration and preceding condensation. It is assumed by several authorities that the use of the increasing dryness method, and therefore, of relatively mercury rich initial increments, would give rise to superior qualities of adaptation, but this has not been substantiated by experimental evidence. However, in the light of the findings published by Wilson, Phillips, and Norman (1957), who showed that the adoption of this procedure gave rise to a restoration having a higher residual mercury content, this technique is to be condemned.

The procedure adopted by most workers is to squeeze the recently triturated amalgam through two layers of a dental napkin or a piece of chamois leather. No guidance is offered, however, upon the actual amount to be removed. This is usually assessed as a result of clinical experience, and will obviously vary from operator to operator.



A B

Fig. 14.—A, Talysurf traces of a specimen taken along line 1 (*above*) and line 2 (*below*) condensed with the Dentatus. B, Photograph of the same specimen. (× 6.)

In this investigation it has been shown that the amount of mercury expelled from the recently triturated mass of amalgam has a slight and relatively insignificant effect upon the quality of adaptation of amalgam to the cavity wall. The best results were obtained by removing 20–25 and 25–30 per cent of the original mercury in the case of hand and mechanical condensation respectively.

These figures conformed to the amount the author would normally expel in clinical practice for each condensation technique. The use of a relatively "drier" amalgam is necessary when using the mechanical condenser, as failure to do so causes an excessive quantity of mercury rich amalgam to rise to the surface during the condensation of the restoration, the removal of which considerably reduces the size of the increment actually remaining in the cavity, and thus prolongs the time required for the condensation procedure. This delay has been shown to be detrimental, as it gives rise to a higher residual mercury content in the completed restoration (Phillips, 1957).

The procedure adopted for the removal of mercury in the investigation was by using a calibrated "G" clamp which is one of the methods available for the expulsion of repeatedly consistent amounts of mercury. However, in the light of the results, the removal of this mercury by squeezing the mass of amalgam through two layers of a dental napkin, using finger pressure, would appear to be acceptable, providing that this is carried out in one stage.

Whereas the degree of plasticity of the amalgam had little effect upon the quality of the relationship of amalgam to the cavity wall, variation of the condensation procedure, on the other hand, did have a marked influence upon this relationship. The best results were obtained by using the mechanical condenser, in this case the Dentatus. The average depths of the spaces between the amalgam specimen and the centre of the cavity wall and along the cavo-surface angle were 25 and 38 micro-inches respectively, compared with 61 and 76 micro-inches, which were the best results obtained by hand condensation. These results confirm the findings of McHugh (1955), who stated that mechanical condensation gave rise to better adaptation than could be obtained with the use of hand condensers.

The results of the experiments with hand condensers emphasized the effect of varying the packing pressure and the shape of the packer point on the adaptation of amalgam to the cavity wall.

Condensation pressures ranging from 2·5 to 15 lb. have been suggested by various workers.

This investigation showed that, by using conventional hand grips, i.e., a Pen or a Palm grip, pressures over 10 lb. were difficult to achieve and impossible to maintain with consistent accuracy. Moreover, in a further investigation, the average packing pressure exerted by 40 dental practitioners for the condensation of an amalgam restoration was found to be 5·8 lb. with extremes of 2·5 and 9 lb. This figure is similar to that quoted by Taylor (1930).

As the major portion of this investigation was devoted to varying the packing pressure on hand condenser No. I, pressures of 2–12 lb. were used. These are equivalent to 700 and 4200 lb. per sq. in. respectively. In order to achieve pressures over 10 lb., unconventional hand grips had to be used, which would not have been practical in clinical practice.

The results showed that the quality of the relationship of amalgam along the cavo-surface angle of the cavity was closest under a condensation pressure of 2800 lb. per sq. in. and deteriorated markedly at higher pressures, whereas the relationship to the cavity wall became closer until pressures of 3500 lb. per sq. in. were reached, after which significantly little improvement was apparent. It follows, therefore, that the optimum hand pressure required in order to achieve the best all-round relationship of amalgam to the cavity wall is 2800 lb. per sq. in., which entailed a pressure of 8 lb. on hand condenser No. I. At this pressure the average sizes of the spaces between the amalgam specimen and the cavity wall and along the cavo-surface angle were 66 and 140 micro-inches respectively. The deterioration in the relationship along the cavo-surface angles at higher pressures is no doubt due to the difficulty in controlling the condenser point at those pressures, together with the fact that the condenser point did not gain access to those areas.

Having established that the ideal packing pressure was 2800 lb. per sq. in. using hand condenser No. I, the next series of experiments was concerned with the effect on adaptation of using a condenser point (condenser No. II) whose shape enabled it to gain access to the line angles as well as to the angle formed by the glass matrix and the cavo-surface of the cavity. Sweeney (1941) claimed that amalgam restorations condensed with shaped packer points, fitted to a specially designed handle, gave rise to fillings whose properties were equal to those condensed by the Hollenbeck condenser, as measured by the amount of flow and residual mercury. He made no claim, however, regarding the quality of adaptation of those restorations.

The results showed clearly that, using a packing pressure of 2800 lb. per sq. in., the relationship of the specimen to the centre of the cavity wall was similar to that produced with hand condenser No. I, but the average size of the spaces between the amalgam and the cavity along the cavo-surface angle was only 76 micro-inches, which is half that which obtained in the previous series. This result clearly emphasizes the importance of choosing the correct shape of condenser point relative to the line angles of the cavity.

The results of the residual mercury analyses showed that the specimens condensed with hand condensers at 2800 lb. per sq. in. in experiments 1 and 2 had an average residual mercury content of 48·5 per cent, whereas in those condensed with the Dentatus the value was 46·7 per cent.

These figures compare very favourably with a value of 55 per cent which was the average amount of mercury found in 20 amalgam restorations removed from patients' mouths.

Although the use of the hand condenser cannot produce results comparable to the mechanical condenser, it is still widely used in dental practice. It has been shown that the selection of a condenser point whose shape will enable it to gain access to the line angles of the cavity is of paramount importance if optimum relationship of amalgam to the cavity wall is to be attained. In the light of all the results, stress must be laid on the need to exert a condensation pressure of at least 2800 lb. per sq. in.

It would seem desirable, however, that the use of a mechanical condenser, such as the Dentatus, should be advocated for routine use in the condensation of amalgam. The use of this instrument, together with a strict

adherence to the manipulative procedures carried out in this investigation, will not only give rise to good adaptation of amalgam to the cavity wall, but also ensure that all the other attributes of the material are enhanced.

SUMMARY

1. A study was made of the effect on the relationship of amalgam to the cavity wall as influenced by varying:—

a. The amount of mercury expelled from the amalgam immediately after trituration and prior to condensation.

b. The condensation method.

c. The condensation pressure.

2. One hundred and ninety-four amalgam specimens were made by condensing amalgam into an artificial cavity which was designed to simulate the proximal aspect of a typical Black's Class II cavity.

3. The quality of the relationship of the amalgam to the cavity wall was assessed by means of the Talysurf surface analyser.

4. So long as the amount of mercury expelled from the amalgam was within the range of 20–25 per cent of the original quantity of mercury in the case of hand condensation, and 25–30 per cent for mechanical condensation, it was found that this variable had a relatively insignificant effect upon the relationship of amalgam to the cavity wall.

5. The ideal pressure required in the hand condensation techniques was found to be 2800 lb. per sq. in.

6. Using a condenser point whose outline enabled it to gain access to the line angles of the cavity and the angle formed by the cavo-surface angle and the matrix band, the average size of the spaces between the amalgam specimen and the cavity wall was 61 micro-inches, and along the cavo-surface angle it was 76 micro-inches.

7. Using a condenser point circular in outline, the respective figures were 66 and 140 micro-inches.

8. Mechanical condensation using the Dentatus vibrator produced the best results. The average size of the spaces between the amalgam specimen and the cavity wall was 25 micro-inches, and along the cavo-surface angle it was 38 micro-inches.

9. The average amount of residual mercury present in the specimens was 48·9 per cent.

Acknowledgements.—The author wishes to express his gratitude and appreciation to Professor H. G. Radden for his advice and encouragement throughout this study.

Grateful acknowledgement is also made to Professors E. Matthews and H. Wright Baker who placed apparatus in their laboratories at the author's disposal, and to Mr. B. Shelmerdine and other members of the staff of the Turner Dental School and the Mechanical Engineering Department of the Faculty of Technology, who made helpful comments. The Department of Medical Illustration (Director: Dr. R. Ollerenshaw) has been of invaluable assistance in producing the diagrams.

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Acceleration of Gingival Wound Healing in Non-epileptic Patients receiving Diphenylhydantoin Sodium (Dilantin-Epanutin)

Diphenylhydantoin sodium was given to patients who were being treated by gingivectomy, with a view to studying its value in increasing the healing rate. It was found that there was a marked acceleration in the healing at the end of one week in the experimental group, compared with the control group. Few and minor side reactions were noted.—Shapiro, M. (1959), *Parodontologie*, **13**, 56.

DIAGNOSIS*

By A. BRYAN WADE, B.Ch.D., F.D.S. R.C.S.

It would be churlish and indeed ungracious were I not to express immediately my profound appreciation of the honour you have accorded me by electing me President of this Society. One of the earlier Presidents, Mr. Sam Cripps (1951), suggested in his address that one of the tasks of this Society was "to develop a group of younger men who will carry on the tradition of the Society". It was perhaps with these thoughts in mind that I was invited to occupy the seat on Council vacated by Mr. Cripps when he returned to Canada shortly after the termination of his presidential year. May I present myself as one of the younger members of the Society, and promise that I will make every endeavour to bring to my office the spirit of enthusiasm, so traditionally associated with youth, tempered, I hope, by discretion derived from an ever increasing number of grey hairs.

There can be no doubt whatsoever that a growing number of younger men in our profession have had their minds alerted by enlightened teaching and are now fully aware of the significance of the periodontal tissues. Equally gratifying is the way in which so many of the more senior men have realized that dentistry as practised formerly was inadequate and was largely a repair service which in far too many cases culminated in the fitting of full denture prostheses. A steady increase in the membership of this Society and the continuing demand for postgraduate instruction in periodontology bear testimony to these facts.

During recent years there has been a marked change in the way in which dentistry is taught to the undergraduate student. The approach is becoming more and more biological, while still maintaining, and even improving upon, former technical standards. Students are encouraged to regard patients' mouths as functional units, rather than collections of individual teeth, and to remember always that the mouth is but a part of the whole body. Full mouth dentistry is now the vogue and cannot be practised without periodontal knowledge. It was in 1952 that the President of this Society, Mr. Leatherman, invited all those teaching periodontology to meet together and discuss matters of mutual concern and interest. That meeting was a great success and has been followed by annual meetings which serve a most useful purpose. Undergraduate teaching has been further stimulated by the award of the Society's prize, and it will be interesting to observe the progress of those who have won this prize. The standard of entries has been very high and augurs well for the future of periodontology.

Mr. Leatherman (1952) in his Presidential Address made a plea for the teaching and practice of periodontics to be based on a thorough knowledge of the tissues involved—a careful diagnosis—painstaking treatment—and the continuous and constant co-operation of the patient. Last year Mr. Hamish Thomson (1959) delivered an inspiring address devoted to the challenge of prevention, and an attempt was made to maintain this theme throughout the monthly meetings. This year Council decided to follow this example and has accepted the second of Mr. Leatherman's pleas—a careful diagnosis.

Mr. Leatherman was wise to qualify the word "diagnosis" with the adjective "careful", for diagnosis is a procedure demanding infinite care and painstaking attention to detail. It needs little thought to appreciate the tremendous significance of diagnosis. It is the foundation upon which treatment is planned; the unveiling of the causative factors of the disease; the basis on which a forecast of the future can be made. Oral diagnosis is not a simple matter, and it is a thousand pities that the phrase "simple diagnosis" has crept into our jargon. Yet what do we find in the General Dental Service? We find the item—Examination and Report Fee. The fact that

* Presidential Address delivered to the British Society of Periodontology, October 12, 1959.

our proceedings are read beyond the shores of Britain prevents me from stating the niggardly fee which this item earns. But the item is "Examination and Report"! This is the task which the motor mechanic performs when investigating the poor inanimate creature which thrives on petrol and is lubricated with oil. Examination is not synonymous with diagnosis when caring for human beings. A diagnosis based on examination alone is in grave danger of being both incorrect and incomplete.

Every diagnosis should be based on an adequate history followed by a thorough clinical examination. The whole essence of success is method. Without method much will be missed and every doctor and dentist must develop and pursue his diagnostic method in each and every case no matter how simple the task may appear initially. Now is not the time to describe the method which I use and teach, for I have already done this in a book which will be published very shortly. I would say, however, that there are few occasions on which a mouth can be properly assessed in less than half an hour, and the need for additional investigations can materially lengthen this time. One of the greatest omissions made in the process of dental diagnosis is a failure to examine the occlusion, not only in the position of centric jaw relationship, but also during the lateral and protrusive excursions of the mandible. Though the significance of occlusion in both health and disease may not yet be fully understood, there is little doubt that it is a factor of very real and major significance. There is a great need for more research into the intimate relation between occlusion and the periodontium. Until there is a greater understanding of this relationship much that is practised in dentistry will be empirical.

CONSULTATIONS AND SPECIALIST TREATMENT

It should be possible for the general dental practitioner to diagnose and treat adequately most of the patients who seek his advice, but there will always be some periodontal diagnostic problems which are too difficult for him, and on such occasions he will wish to refer the patient to a consultant. But the number of men who are recognized as consultants in periodontology either in private or in hospital practice is regrettably small: there is not even one in every teaching hospital. It surely cannot be doubted that there is a need for more consultants and specialists in periodontology. The small number who are in private practice are constantly in demand, while in some hospitals men who have insufficient experience of periodontology are being asked to give opinions. They are, often, the most senior men available and, though it may be unfair to both them and the patients that they should be asked to perform work which rightly belongs to a consultant periodontologist, in the absence of such a person it is all that can be done. Experience only comes with the passage of time and cannot be hastened, but it is very important that these men be kept in periodontology so that they will be worthy of consultant status in only a few years' time.

How can the number of specialists be increased? First, by creating more junior appointments in our teaching hospitals. There is a need for such appointments in all departments, for a man cannot be a competent periodontologist unless he has a sound basic knowledge of all aspects of dentistry, and conversely a potential specialist in some other branch should benefit from holding a junior appointment in periodontology. There is little point in creating these junior appointments, however, unless the prospects are good; there are few enough applicants for the present posts. Of those who start as house surgeons and demonstrators only a small number continue the long slow climb. At senior lecturer level an advertisement may produce an almost negligible response, and to have no applicants for posts of lecturer or senior registrar grade is by no means unknown. Why do so few continue to climb? There are several reasons, but financial considerations in the majority of cases are the deciding factors which force the young man into general dental practice. He enters general practice not as his first choice, but as the only way in which he can gain the reward he sees his contemporaries receiving.

The root of the problem would seem to be the reward which the senior man is to receive. This amount must be substantially in excess of that earned by the general practitioner. It is illogical to suggest that the consultant should receive less than the referring practitioner.

Consultant status is earned, not given. By presenting papers and demonstrations, by conducting postgraduate courses, by giving opinions which prove to be correct, and by performing treatment which is effective—only in these ways does a man become recognized by his colleagues. When he is accorded this recognition he is a consultant. There would seem to be a limit to the salary these men might reasonably receive from the public purse, and, though to many people this reward might seem adequate, in fact it has proved inadequate as is shown by the dearth of those applying for junior appointments.

Any policy whereby a man specializing in periodontology received a greater share of public money than his counterpart in another faculty of the university or branch of the Health Service would be a dangerous one and lead to discontent. The extra amount must come, therefore, from private rather than public sources. The man who has reached consultant level in his speciality should be given the opportunity to practise both in hospital and privately. The custom of 8/11 and 9/11 appointments in the National Health Service hospitals, and the Swedish system whereby the professors must spend at least 5 hours daily in the Dental High Schools, after which they are free to practise privately, are excellent and should be encouraged. If more widely practised in our schools and hospitals, I believe that there would be no shortage of extremely suitable candidates for many more posts than there are at present.

My thoughts have caused me to stray from the theme of diagnosis in its more medical sense. I hope I may be forgiven for making my diagnosis of what I consider to be a matter which is fundamental to the progress of periodontology, and I hope that the suggested treatment is one which will be acceptable not only to you but also to those in whose hands such decisions lie. I feel confident that there is a good prognosis and I know that there are many who are in full accord with my sentiments.

HIGHER QUALIFICATION IN PERIODONTOLOGY

Academic achievement should go hand-in-hand with promotion. There are some who believe that a higher qualification is mandatory before a speciality is established. They would, therefore, like to see one or more of the Royal Colleges award a higher diploma in periodontology, similar to those in orthodontics. Already higher university degrees can be granted for original work in periodontology or some related field, and in the future few can hope to reach senior status without having gained a Fellowship in Dental Surgery. Attaining first a fellowship and then a higher degree would seem to follow the examples set in other specialities of medicine and to be wholly desirable. The American Academy of Periodontology awards a diploma on the results of an examination taken after 3 years of practice devoted principally and primarily to periodontology and 2 years of formal education and training in periodontology at an approved institution. Such a custom is alien to specialist societies in Britain. It would seem that the desire for a specialist qualification in periodontology is a matter which this Society will soon have to consider and pronounce upon. It might well be that abolition of the distinction between full and associate membership will hasten the date.

ANCILLARIES

Throughout the life of this Society the words "ancillaries" and "dilution" have been bandied about a great deal by members of our profession, and frequently a somewhat sinister meaning has been attached or implied. Now we learn from Sir Wilfred Fish (1959), our Founder President, in his President's Address at the opening of the ninth session of the General Dental Council, that the Ministry of Health is negotiating with teaching hospitals which have shown an interest in training dental hygienists. All who have worked with dental hygienists appreciate their great contribution to dental health. They are imbued

with a singularly impressive devotion to their work and it must be gratifying to members of this Society to learn that they are not to become obsolete. It has always been the policy of the British Society of Periodontology to welcome and encourage dental hygienists, and we are proud that some of our members were pioneers in their introduction to Britain.

Sir Wilfred (Fish, 1959) also announced the inauguration of an experimental scheme to train dental auxiliaries. These auxiliary workers should be of great assistance to dental surgeons for they will be trained to carry out some of the more technical and mechanical procedures of dental therapy. They will not be diagnosticians, and they will not prescribe treatment. These functions must for ever remain the sole right of the man who has had a training which has been fundamentally biological. The importance of diagnosis looms ever greater, and no man who is a competent diagnostician need have any fears about the introduction of these auxiliaries: rather should he welcome them as assistants who will enable him to devote more care and attention to a careful assessment of the stomatognathic system, as some would call it, for that is his real responsibility. Dentists must be physicians and surgeons, not technicians.

RESEARCH

During programme planning certain events occurred which warranted deviations from the strict theme of diagnosis. First, two of our members, Mr. Baird and Mr. McHugh, reported that they had original work to communicate and, ever mindful that the object of the Society is to promote and advance the study of periodontology, Council immediately took steps to find a place for them in the programme. Research must be encouraged by every possible means and this Society must afford an early opportunity for any member to present original work. In recent years a British section of the International Association of Dental Research has been created and provides an opportunity for new knowledge of all aspects of dentistry to be reported and discussed, but major research in periodontology should be presented in the first instance to this Society.

SYMPOSIA

Secondly, a request was received from members asking for more symposia. These provide a way of presenting short communications which is preferable to linkage with a major paper, and this year there will be two such meetings. At one of these some of our younger members will address the Society, and at the second meeting we look forward to hearing the recipients of the 1959 Gibbs scholarships extend the theme of last year's programme when they report on their recent visit to the United States of America.

INTERNATIONAL CO-OPERATION

The third way in which Council deviated from the initial concept was to arrange a series of presentations by leading Scandinavian authorities on certain aspects of periodontology. International co-operation is of immeasurable importance. By welcoming guests from other countries, and by encouraging our own members to travel abroad, the British Society of Periodontology is making its own contribution towards international understanding and co-operation. I am sure that you will be pleased to welcome our Scandinavian guests, and that there will be a record attendance at the meetings which are being arranged. At this time there will also be a joint meeting with the British Society for the Study of Prosthetic Dentistry in furtherance of the policy outlined by Mr. Leatherman in his Presidential Address in 1952.

CLINICAL MEETINGS

It is a matter of real regret that no space has been found in the programme for a clinical meeting. Such meetings afford members who are in general practice an opportunity to see patients who have been under the care of those who are limiting themselves to periodontology. The process of diagnosis can be appreciated and discussed with the clinician presenting the case, and often the results of his treatment can be observed. But I am sure that replacement of the clinical meeting by the Scandinavian lecturers will more than compensate for the omission, as much of their material will be of a clinical nature.

WARWICK JAMES

This session marks the beginning of the second decade in the life of this Society. It also marks memorable occasions in the lives of two of our honorary members.

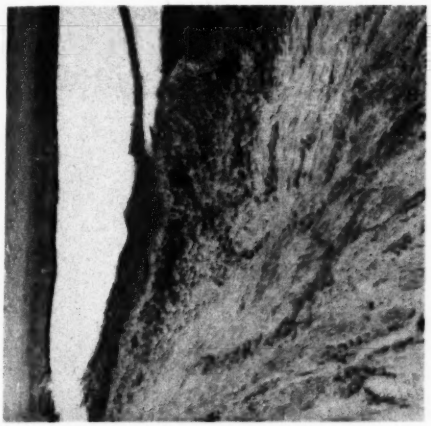

Fig. 1.—"Zone of injury" on mesial aspect of a mandibular first premolar (frozen section). (× 120.) (*Figs.* 1–8 *by courtesy of W. Warwick James.*)

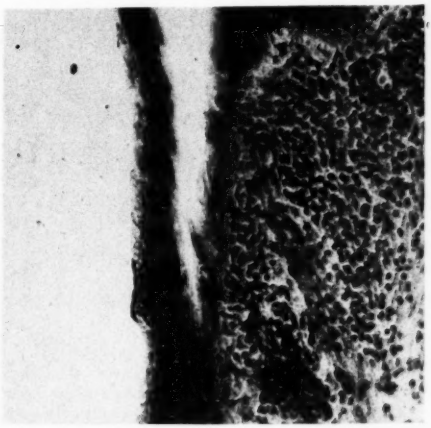

Fig. 2.—Higher magnification of "zone of injury" shown in *Fig.* 1 revealing dense leucocytic infiltration. (× 200.)

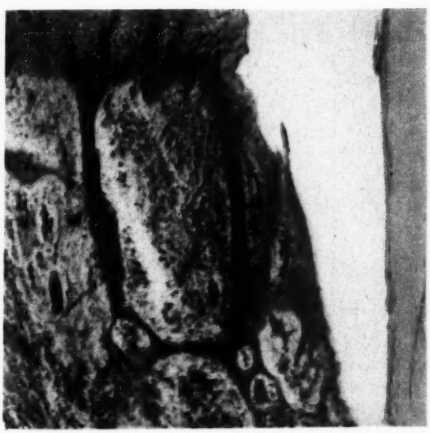

Fig. 3.—"Zone of injury" with proliferation of subgingival epithelium. Mandibular canine from case of chronic periodontitis. (× 120.)

Fig. 4.—Same section as *Fig.* 3 showing more apical site revealing that the path of inflammatory infiltration is not into the periodontal membrane. (× 120.)

William Warwick James recently celebrated his eighty-fifth birthday. In 1927, in conjunction with Counsell, he read to the members of the Metropolitan Branch of the British Dental Association a paper on "A Histological Investigation into 'so-called Pyorrhœa Alveolaris' ", which was subsequently published in the Journal of that Association (James and Counsell, 1927). In the same year at the Annual Meeting of the Association in Leeds he displayed their material under 30 microscopes,

yet he tells me that only one man bothered to halt awhile and examine it! Such is the folly of man, and it is not surprising that little credit has been given to Warwick James and Counsell for showing that the path of invasion in chronic marginal periodontitis is through the gingival corium to the alveolar bone, and later the periodontal membrane. The periodontal membrane is the last tissue to be involved in the process of infiltration. These conclusions have been endorsed subsequently by Thoma and Goldman (1937), Kronfeld (1939), Box (1940), Weinmann (1941), to whom most credit is usually given, and again Goldman (1957).

Fig. 5.—Inflammatory infiltration along the route of the lymphatic drainage and the capillary vessels into the bone and the attached gingiva. (× 120.)

Fig. 6.—Higher magnification of *Fig.* 5 showing involvement of marrow space. (× 200.)

Fig. 7.—Higher magnification of *Fig.* 5 showing periodontal membrane which is almost free from any inflammatory cells. (× 200.)

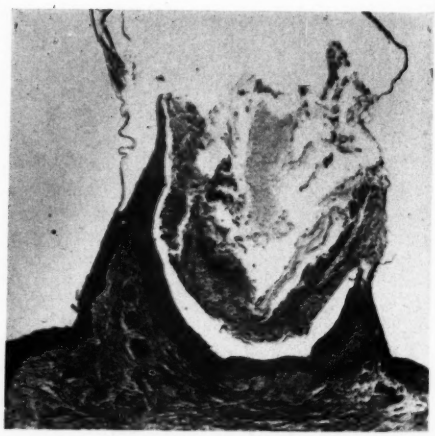

Fig. 8.—Interdental papilla between left mandibular premolar and first molar, cut in mesiodistal plane, showing the reduced enamel epithelium (Nasmyth's membrane) extending to form the layers of the epithelial attachment adjacent to the space occupied by the enamel before decalcification. (× 48.)

Mr. Warwick James has given me the slides he used to support his paper in 1927 and I propose to share my good fortune with you by showing a few of the most important ones, confident that you will be more appreciative than those members of our profession who were present at that year's Annual Meeting of the British Dental Association (*Figs.* 1–8).

PROFESSOR WILKINSON

Professor Frank Clare Wilkinson, another of our honorary members, has just retired from the Directorship of the Eastman Dental Hospital and Institute of Dental Surgery of the University of London. He, too, made a significant contribution to periodontology when, in 1934, he (Wilkinson, 1935) read before the Liverpool Odontological Society a paper entitled "A Patho-histological Study of the Tissue of Tooth Attachment", in which he presented the results of research work showing the precise way in which a pocket is formed. This work is widely quoted in text-books on periodontology. Professor Wilkinson has been a particularly good friend of the Society, for it is through his kindness and that of the Board of Governors that most of our meetings have been held at the Eastman Dental Hospital.

I am sure that it is your wish that I should convey to Professor Wilkinson and Mr. Warwick James our hopes for many more years of healthy activity, for they are both men possessed of active and inquiring minds which interpret retirement as an opportunity to work even harder. They have set magnificent examples to the members of this Society and it is our responsibility to see that their examples are followed.

The first decade in the history of our Society has seen considerable advances in periodontology and the knowledge gained is being ever more widely disseminated. Let us see that this progress continues.

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Subclinical Scurvy and Subclinical Tooth Mobility

Four adults were used in an experiment to test the relation between ascorbic acid and tooth mobility. The methods of assessment were by the ascorbic acid fasting level and the intradermal test, together with recording of tooth mobility, by means of the Muhlemann periodontometer.

A daily dose of 1000 mg. of ascorbic acid was given to all 4 subjects for a period of 8 weeks, during which time there was no supplementation.

In 2 subjects the ascorbic acid level and tooth mobility range were found to be within normal limits and remained so throughout the entire period of the experiment. In the other 2, however, the ascorbic level was down and the intradermal time raised at the beginning of the experiment. In one of these subjects the range of tooth mobility was below normal, but in the other who had had orthodontic treatment as an adult the range was excessive. During the period when ascorbic acid was administered the levels in both individuals became normal, while the teeth loosened to normal limits in the one where the range had been subnormal, and in the individual who had had orthodontic treatment the teeth tightened.

In the subsequent period of observation, the ascorbic acid levels and intradermal times appeared to return to their original values and there was evidence that tooth mobility was also tending to revert to the figures found at the beginning of the experiment.—Karlson, F. A., Cheraskin, E., and Dunbar, J. B. (1959), *J. West. Soc. Periodont.*, **7**, 6.

AN UNUSUAL CELLULITIS OF THE FLOOR OF THE MOUTH

By **M. O. HINDLE**, B.D.S., L.D.S.

Turner Dental School, University of Manchester

CASE REPORT

A FEMALE patient, aged 35 years, presented at the Hospital with a submandibular swelling and complaining of a pain in the right lower jaw of 2 weeks' duration. The pain had become constant and severe 2 days previously, when the swelling first appeared.

The patient gave a history of submandibular swelling during childhood resulting in "some glands" being enlarged, which subsided after dental extractions. No other dental troubles had been experienced and the medical history did not appear relevant. The patient had received one injection of intramuscular penicillin from her medical practitioner the day before.

EXAMINATION.—The submandibular swelling extended from the midline to the right mandibular angle, occupying the right submandibular fascial space. Palpation revealed it to be soft, diffuse, and relatively painless. Hard, discrete, symptomless upper deep cervical glands were also palpable.

Examination of the mouth showed teeth present to be $\frac{7654321|123\ \ 7}{7\ \ 4321|12345\ 7}$. The $\overline{7}|$ was very carious, but not mobile and not showing any signs of periodontitis. No other carious lesion was present in this quadrant and the parodontal condition was fair.

The floor of the mouth was very inflamed and tender in the $\underline{8—2}|$ region and the cellulitis had raised the tongue upwards and backwards, causing some difficulty on swallowing. Trismus was absent. The swelling had been present for 2 days only and there was no history of intermittent swelling or discomfort after meals during the previous weeks. The temperature was 99·2° F.

A lateral oblique roentgenogram (*Fig.* 1) showed a very carious $\overline{7}|$, with periapical rarefying osteitis, calcification in the cervical glands, and what was taken to be an unerupted premolar tooth lying obliquely in $\overline{65}|$ region, which was then thought to be non-contributory to the condition. Periapical films which would have given finer detail of the area in question were impossible to obtain because of the cellulitis. As submandibular duct obstruction was not suspected a true occlusal film, which would have revealed any stone formation in the duct, was not attempted.

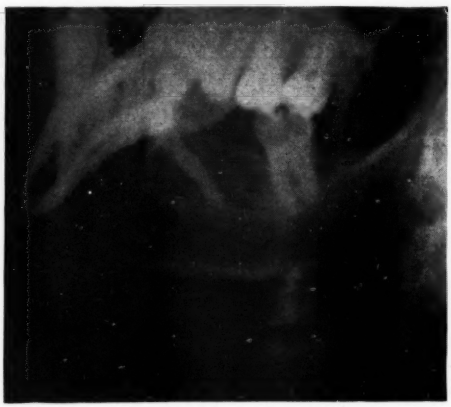

Fig. 1.—Lateral oblique radiograph showing periapical rarefaction of the grossly carious $\overline{7}|$ and the (supposedly) unerupted $\overline{5}|$.

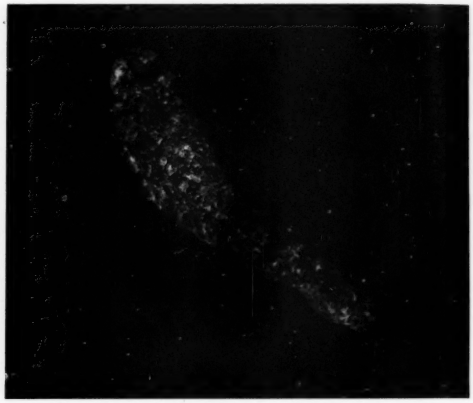

Fig. 2.—Calculus removed from right Wharton's duct. (× 2.)

At this stage a diagnosis was made of an acute lingual cellulitis arising possibly from a chronic periapical condition of the second lower molar.

TREATMENT.—Following extraction of the second lower molar under general anæsthesia, palpation of the lingual sulcus revealed a hard body in the anterior end of Wharton's duct, and slight pressure over this area extruded a long club-shaped calculus from the orifice (*Fig.* 2). No discharge was detected following this. As the patient had received penicillin previously from her medical practitioner, the course was continued by giving 1·2 mega units of Penidural (all-purpose) intramuscularly. Two days later the lingual swelling was reduced, the temperature normal, and the patient free from discomfort. The swelling had resolved completely 6 days later.

DISCUSSION

This case is reported for two reasons. First, the rapid onset of a cellulitis is not a usual feature of submandibular duct obstruction,

unless this is complete. Secondly, it illustrates that the superimposition of calculi on dental structures as they appear on X-ray films can be very misleading. These points may be brought out further by considering the principal features in the differential diagnosis.

The most likely cause of an inflammatory swelling in this region is either from an acute infection of dental origin, or as a result of submandibular duct obstruction.

Fig. 3.—Another example of the superimposition of a calculus on dental structures in a radiograph.

The predominating symptoms and signs indicated the former in that typical features of an acute alveolar abscess were present:—

1. The pain was severe and constant for a short time.
2. There was an associated swelling, and
3. A raised temperature.
4. Periodontitis, which is a usual sign, was absent. However, this was not thought to contra-indicate the diagnosis because of the particular root anatomy of the second lower molar. An infective process spreads along the line of least resistance. As the apices of the lower second molar are curved, lying nearer the lingual rather than the buccal alveolar plate, it is possible that the infective process had rapidly pierced the lingual plate, as the area was subject to a chronic periapical condition causing the destruction of the surrounding bone. This would lessen the chance of pressure being built up by the inflammatory exudate in the periodontal membrane to give periodontitis, but would involve the sublingual or submandibular fascial space, depending on whether the lingual alveolar plate was pierced above or below the origin of the mylohyoid muscle.
5. Trismus was not present. Trismus is a common feature of acute alveolar abscesses in the mandible when the area involves muscles which act on the temporomandibular joint. This was not so in this case, and Thoma (1952) states that trismus is rare in cases of submaxillary cellulitis.

Fig. 4.—True occlusal radiograph of case shown in *Fig.* 3, establishing that the opaque body is a calculus in the right Wharton's duct.

6. Acute lymphadenitis was not present. The degree of lymphadenitis depends on the severity of reaction in the lymph-gland to the toxic products and bacteria draining into it. Here the cervical lymph-nodes were symptomless, but enlarged, indicating a long-standing inflammatory reaction most likely as a sequel to the enlargement during childhood. In support of this the roentgenogram indicated that calcific degeneration had taken place in these glands.

Submandibular duct obstruction is characterized by:—

1. Swelling generally limited to the submandibular gland, which may or may not be tender. The gland here appeared relatively painless but the cellulitis prevented adequate bimanual palpation.
2. Intermittent pain and enlargement of the swelling before and at meal times. Inquiries elicited a very definite "No" to these signs and symptoms, and insistence that no swelling

or discomfort had been noticed until 2 days beforehand.

3. Inflammation of the secretory papilla. The cellulitis involving the floor of the mouth on the right side included the papilla, which, however, did not manifest any discharge. It is apparent that apart from the inflammation involving the secretory papilla, typical features of a submandibular duct obstruction were not evident, and it was therefore not unreasonable to attribute the cellulitis to the periapical lesion. An occlusal roentgenogram would have corrected this impression, and periapical films with their finer detail might have revealed the lack of periodontal membrane on the supposed unerupted premolar.

The calculus measured 3·0 cm. in length and must have taken many months to form. It is remarkable that it had not caused any discomfort until this acute episode. A further example is illustrated in *Fig.* 3. This patient, aged 73 years, had a large calculus in the right submandibular duct, which was discovered by accident. It was entirely symptomless, but was revealed in an occlusal X-ray film (*Fig.* 4).

It has been stated by Payne (1937) that an acute infection as a complication of a calculus in the duct is due to the impaction of the calculus at some part of the duct, and in practically all cases an ascending infection from the buccal cavity. Provided that salivary flow is not impeded a calculus will remain symptomless, but sudden partial or complete restriction to the flow will produce distension in the gland, pain, and subsequently infection.

SUMMARY

A case of cellulitis of the floor of the mouth resulting from duct obstruction and wrongly attributed to periapical infection is described, and the differential diagnosis of such cases discussed.

Acknowledgements.—My thanks are due to Professor H. G. Radden for his kind permission to publish this case, also to the Department of Medical Illustration, Manchester Royal Infirmary, for the illustrations.

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BOOK REVIEWS

PATHOLOGIC PHYSIOLOGY OF ORAL DISEASE. By RICHARD W. TIECKE, B.S., D.D.S., M.S., F.A.C.D., Professor of Pathology, Northwestern University Dental School; ORION H. STUTEVILLE, B.S., D.D.S., M.D.S., M.D., Professor and Chairman of the Department of Maxillo-facial Surgery and Chairman of the Department of Oral Surgery, Northwestern University Dental School; and JOSEPH C. CALANDRA, M.D., Ph.D., Professor and Chairman of the Department of Pathology, Medicine, and Bacteriology, Northwestern University Dental School. $9\frac{3}{4}\times6\frac{3}{4}$ in. Pp. 480, with 637 illustrations. 1959. St. Louis: The C. V. Mosby Co. (London: Henry Kimpton.) 86s.

THE authors state that the guiding theme in the preparation of their book was to correlate the clinical aspects of oral disease with the microscopic pathology of such diseases. For the greater part the authors succeed in fulfilling their aim, but the inclusion of surgical and medical therapy makes this book more suited to the clinician than to the pathologist. The title may therefore be somewhat misleading.

The book is mainly to be praised for the outstanding collection of clinical photographs representing a wide variety of oral lesions. These have been drawn from a broad clinical field, and are used to very good purpose in illustrating the concise and easily readable text. The histological descriptions of individual lesions tend to be rather short and the standard of the accompanying photomicrographs is variable.

The lesions of the soft tissues of the oral cavity, cysts and neoplasms of the jaws, and disorders of the salivary glands are, however, well presented and comprise more than

two-thirds of the book. The other important dental specialities such as dental caries and periodontal disease are presented in a form so condensed as to make their inclusion of little additional value.

One or two chapters in particular entice criticism. For example the inclusion of six clinical case histories in the chapter dealing with metastatic tumours of the jaw is out of line with the remainder of the book, particularly as so many cases of this nature have already been reported in the scientific journals. Also the chapters on diseases of the temporomandibular joint and pathology of the pulp would benefit by a stricter use of basic terminology.

Finally, this book can be recommended to the clinician, medical or dental, mainly for the graphic presentation of the soft tissue lesions of the oral cavity, and in view of the very large number of illustrations the book is reasonably priced.

H. J. J. B.

THE MOUTH. ITS CLINICAL APPRAISAL. By A. B. Riffle, D.D.S., formerly Chief of the Dental Service at the Rochester General Hospital, American Academy of Periodontology. $7\frac{1}{4}\times4\frac{3}{8}$ in. Pp. 118+viii, with 22 illustrations. 1959. Philadelphia and Montreal: J. B. Lippincott Company. (Distributed in Great Britain by Pitman Medical Publishing Co. Ltd.) 28s.

This book, of some 100 pages, addressed as it is to the medical practitioner, has given me great interest while I have been reading it. It loses nothing by its transatlantic approach, and since it does not set out in any way to be a text-book on the subject, its aspect is general rather than detailed. This does not mean that it is light bedtime reading, but it is presented in a form that can be read in the odd half-hour at the end of a day's work.

In England, where the division between all branches of dental surgery and medical practice is, alas, quite great, this little book should bridge a gap between the two professions and be a help to any medical practitioner entering into the territory common to both, the mouth, in which many doctors have a feeling that they may be interlopers. While this is obviously not a true feeling, the attitude does, I think, exist in some measure.

The impression that I am left with is one of a stimulation not to confine my oral interests to a search for Koplic spots, nor to an appraisal of tonsils and adenoids, but instead to use my pseudo-dental eye to greater advantage.

My one fear is that this book and others of this kind may not receive the attention they merit in these days when the demands of the National Health Service have lamentably left the medical practitioner with an inadequate time to live, to enjoy his home and family, let alone an inadequacy of time to pursue interest beyond the ordinary run of day-to-day work.

J. E.

LETTER TO THE EDITOR

November 19, 1959

Dear Sir,

Perhaps you will be good enough to allow me further space in your columns to reply to Mr. Grundy's letter.

He says that polishing will bring satisfaction to both patient and practitioner and that functionally it will reduce corrosion and food stagnation. What he cannot answer, however, is the question of local overheating during polishing on the surface of the amalgam, or the degree to which polishing will reduce corrosion or food stagnation over finishing with alternative methods, such as finishing burs, or fine stones under spray. It is not enough to say this is better; one also requires to know how much better. Indeed, I cannot recall seeing signs of food stagnation on smooth but unpolished fillings in mouths with good oral hygiene.

The point of my letter was that in an imperfect world, it is more important to concentrate on eliminating caries, calculus, overhanging edges, and ensuring good marginal ridges and tight contact points, etc., than to accuse hard-working practitioners of dishonesty (the Editorial —short shrift) if they fail to polish restorations. It is a question of clinical judgement to decide what is a reasonable and satisfactory treatment for a given patient, in the light of known facts. We would all like the best for everybody, but whereas in general practice the economics of life must be studied, we should seek to acquire more knowledge and improve our methods, rather than to comment on the common sense or, let's say it, the supposed laziness or money-grubbing of colleagues.

If I honestly were convinced that polishing was an essential part of treatment I would do it, but the continual sight of far worse than this, which does not result in marked disease, is a salutary reminder that we are, as yet, far from knowing what is and what is not essential in dental practice.

Yours faithfully,

George E. Ray, F.D.S. R.C.S.

86, *Whitelands Avenue*,
Chorleywood, Herts.

NEW MATERIALS AND APPLIANCES

THE new materials and appliances briefly reported here have recently become available to the profession. For further information the reader should write direct to the manufacturer.

Adrenoxyl

A HÆMOSTATIC agent, Adrenoxyl, which acts by decreasing the permeability and increasing the contractility and resistance of the capillary wall, is now available. It is claimed to be safe, has no effect on blood-pressure, and no side-effects have been reported. Price: 9s. 5d. (plus P.T.) per 25 tablet tube. (Horlicks Ltd., Slough, Bucks.)

Split-beak Forceps

THE advent of forceps with the universal four point contact blades (*see* illustration) which aids deep penetration to well below the junction of the root and crown, which also adapt themselves more readily to the root contours,

has now eliminated the possibility of slipping. The manufacturers claim that, in addition to ensuring a firmer grip, these split-beak forceps will also obviate a great deal of damage and thus permit quicker, cleaner healing of the wound.

Six further patterns are now being made in addition to the two universal types originally introduced. These new patterns have the following applications: For upper anterior roots, central, and lateral teeth; for upper premolar teeth and all roots; for upper wisdom and molar roots; for lower centrals, laterals, premolar teeth, and all roots; for lingually inclined lower roots and wisdom teeth. Price: Uppers £4 14s. 6d. each; Lower £4 9s. 6d. each. (Amalgamated Dental Trade Distributors Ltd., 26–40 Broadwick St., W.1.)

New Scalpel Design

THE Jecker Scalpel is of a new design with a very fine "nib-like" blade incorporating longitudinal grooves to allow drainage of blood and

pus. Applications in the dental field include lancing of abscesses, apicectomy, and gingivectomy, for which it is claimed to be superior to conventional instruments. Price: £1 7s. 6d. (Theranews Imports, 28 Icknield Way, Tring, Herts.)

Ascoxal

A COMPOUNDED tablet of ascorbic acid, sodium percarbonate, and copper sulphate, Ascoxal is indicated in the treatment of acute and chronic gingivitis, stomatitis, and oral mycosis. Also advised for impression taking, its mucus-dissolving action improving sharpness of detail. Price: 5s. for 24 tablets. (Astrapharm Ltd., Watford, Herts.)

Svedopter, Swebond, Dropsin

THE Svedopter combines saliva ejector with mouth mirror, light reflector, and tongue guard. Supplied with free interchangeable reflector blades.

Swebond is a cold cure acrylic material. Two liquids are obtainable—one for processing permanent dentures only, the other for permanent dentures, repairs, and relines.

Dropsin lining material is claimed to replace dentine, to insulate without irritation. It hardens quickly and can be used as a temporary cement for inlays. (Svedia Dental Industri, A.B. Enkoping. U.K. Agents: James Rouse Ltd., Sheffield 1.)

REHABILITATION OF THE CHILD WITH CLEFT LIP AND PALATE

By **DENIS GLASS**, L.D.S. R.C.S. (Eng.), D.D.O., R.F.P.S.G.
Plastic and Jaw Injuries Centre, Queen Victoria Hospital, East Grinstead

It is not generally realized that 8 births per 1000 are congenitally deformed and that of these 8 per 1000 the commonest defect is club-foot (26 per cent), while the clefts of lip and palate amount to 17 per cent (Ivy, 1957).

The occurrence of clefts of lip and palate in this country is at least 1 in a 1000, which means that, annually, between 700 and 800 such children are born who will require specialized attention.

Throughout this paper the term "clefts" is used as a collective term to include all common clefts of lip, alveolus, hard palate, and soft palate, and covers a large variety of defects occurring at the junction of the processes which unite to form the face. These may conveniently be divided into common clefts and uncommon clefts; it is not the purpose of this paper to consider any of the uncommon clefts.

Common clefts have been classified in many ways by the embryologists, anatomists, surgeons, orthodontists, etc.

The anatomical classification is shown in *Figs.* 1–4. *Fig.* 1 shows some varieties of cleft lip varying from a slight failure of the orbicularis oris of the upper lip to complete bilateral cleft of the lip. *Fig.* 2 shows the degrees of unilateral cleft which increased in severity from cleft lip to a complete cleft of lip, alveolus, and hard and soft palate. This may be right or left sided. *Fig.* 3 shows bilateral clefts which vary in severity from bilateral lip to the most mutilating of all clefts—the complete bilateral cleft of lip, alveolus, and palate. *Fig.* 4 shows the isolated cleft of palate only: again this varies from a submucous cleft of the soft palate to complete cleft of hard and soft palate. These clefts are again subdivided into U shapes and V shapes, the former presenting

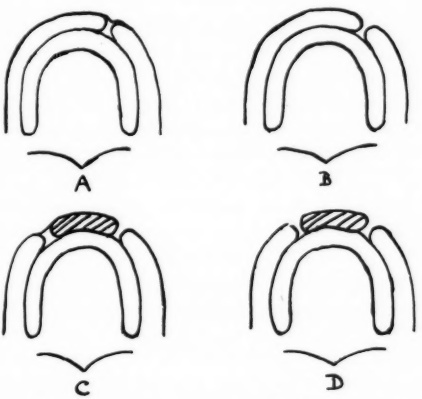


Fig. 1.—Common types of cleft of lip. A, Submucous cleft of lip. The epithelium is intact but the orbicularis oris muscle is cleft. B, Complete cleft of lip. C, Partial bilateral cleft of lip. D, Complete bilateral cleft of lip. The prolabial part of the lip (shaded) contains no muscle tissue.

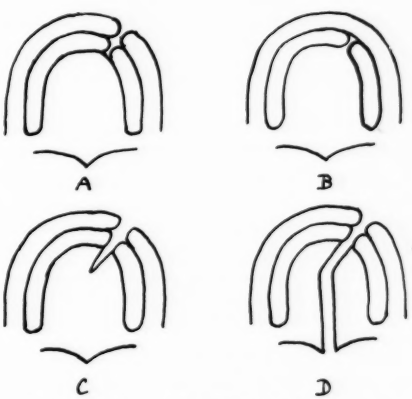


Fig. 2.—Unilateral clefts of lip alveolus and palate. A, Cleft lip and alveolus. B, Cleft alveolus, lip and palate intact. C, Cleft of lip alveolus and anterior part of hard palate. D, Complete unilateral cleft of lip alveolus, hard and soft palate.

Given at the Manchester meeting held on April 17, 1959.

considerable surgical problems when palatal closure is undertaken.

Embryologically and genetically clefts are divided into clefts of lip and palate, and clefts of palate. The clefts of lip and palate occur before the eighth week of intra-uterine life, while the isolated cleft of palate occurs about the tenth to twelfth week of intra-uterine life. These two clefts occur at different periods of development and have a different genetic background.

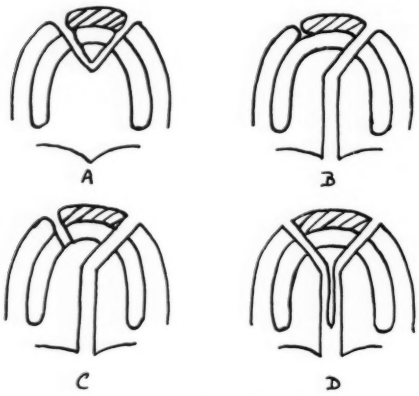


Fig. 3.—Bilateral clefts. The absence of any muscle tissue in the prolabium (shaded) is a constant feature. A, Bilateral cleft of lip alveolus and anterior part of hard palate. The hard palate is intact but the cleft follows the pattern of the premaxilla. B, Bilateral cleft of lip with unilateral cleft of lip alveolus and palate. C, Bilateral cleft of lip and alveolus. Unilateral cleft of palate. D, Bilateral cleft of lip alveolus and palate premaxillary segment is supported by the voma, and the two lateral halves of the maxilla are completely separated.

Having classified the types of clefts, let us now consider the problems which confront the child, and his progress through the early years of life.

The family doctor or midwife is generally the first person to discover that a child has a cleft. The child is then seen at a special centre for rehabilitation of congenitally deformed children.

In "Cleft Centres" the child is seen in the first weeks of neonatal life by a team responsible for the overall treatment plan, who will consider the solution to the combination of problems which confront each individual specialist and whose combined efforts will eventually produce the optimum result when growth is complete.

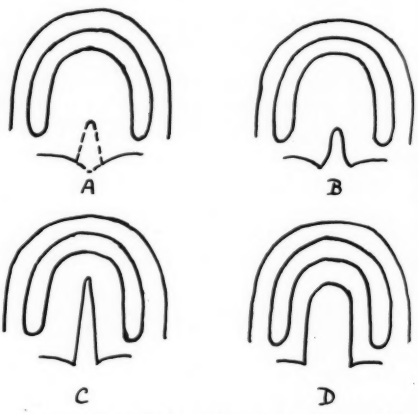


Fig. 4.—Isolated cleft palate. A, Submucous cleft of soft palate; epithelium is intact but there is lack of midline continuity in the muscle of the soft palate. B, Cleft of soft palate. C, V-shaped cleft of hard and soft palate. D, U-shaped cleft of hard and soft palate.

USUAL PROGRAMME

The overall treatment will cover the next 15–20 years of the child's life and will involve some or all of the following:—

Procedure	*Time*
1. Presurgical dental orthopædics	Up to 3 months
2. Surgery, lip closure	3 months
3. Surgery, palate closure	1½ years
4. Dental treatment	From 3 years
5. Speech therapy	From 4 years
6. Dental orthopædics	From 4 years
7. Orthodontics	From 7 years
8. Final surgery	14–16 years
9. Prosthetic treatment	From 16 years
10. Oral surgery	From 21 years

The team of specialists responsible for the rehabilitation of cleft children usually consists of: (1) Plastic surgeon; (2) Speech therapist; (3) Orthodontist; (4) Prosthodontist; (5) Oral surgeon.

Other specialists are of course at hand should their services be needed, e.g., Pædiatrician, E.N.T. surgeon, Psychologist, Radiologist, Anæsthetist, etc., while the family doctor and family dental surgeon must be prepared to devote considerable time to these handicapped children.

Presurgical Dental Orthopædics.—This treatment is carried out in some centres with more enthusiasm than in others. The main object of this treatment is to reposition the segments of the maxilla in the most favourable position and to stimulate normal, and possibly abnormal, growth of the segments, especially the lesser segment in unilateral clefts. In this way contact of the two maxillary segments may be achieved and the deformity due to the lack of tissue is reduced.

In bilateral clefts the early treatment combines the expansion of the two maxillary segments and the repositioning of the premaxillary segment into a position of stability, between the lateral segments.

This treatment is usually carried out in the first few weeks of neonatal life, so that the normal surgical programme is usually not affected.

It is claimed that successful treatment at this age contributes considerably to the final result (McNeil, 1949; Burston, 1958).

Early Surgery.—Opinion differs considerably in different centres as to the most opportune time for lip and palatal surgery.

Early lip closure in the first week of neonatal life is favoured by some teams (Staith and DeKeline, 1938), whereas others delay treatment, especially palatal closure, until after the fifth year (Durrance, 1933; Brodie and Slaughter, 1949). Between these two extremes the usual surgical timing is lip 2–3 months and palate 1½ years.

Those who favour early surgery maintain that the earlier the restoration of normal tissue apposition and function the greater the regenerative and recuperative powers of the tissues themselves, and therefore the greatest overall benefit. Those who favour late surgery maintain that maximum maxillary growth is established by 5 years, after which any surgical effect on growth will cause limited retardation.

Early surgery is divided into two parts: (1) Lip closure; (2) Palatal closure.

1. Lip closure is usually carried out when the baby is 2–3 months old. The object is:—

a. To restore the continuity of the lip.

b. To unite the orbicularis oris muscle, thus permitting normal function of the circumoral musculature during respiration and feeding.

c. To restore normal blood-supply to the parts concerned.

d. To eliminate the æsthetic disability and thereby help the parents and child socially.

2. Palatal closure is usually carried out before the pattern of speech has been established, i.e., when about 1½ to 2 years old.

The main objects of palatal closure are:—

a. To separate the oral and nasal cavities.

b. To permit palatopharyngeal closure and allow normal deglutition and speech.

c. To unite and restore the function of the muscle of the soft palate before the development of the undesirable muscle movements of defective speech.

d. To permit normal tongue movements and posture.

Anæsthesia.—The anæsthesia of these young children presents a considerable problem. The surgical procedures are never life-saving and therefore the most opportune moment must be awaited. Veau (1938) has accepted a mortality-rate of about 3·5 per cent. To-day under up-to-date conditions a rate of 0·5 per cent or 1 : 200 would not be acceptable.

The presurgical anæsthetic requirements are as follows: The child must be in the best of health and conform to the following data (Davies, Russell, and Danks, 1953):—

1. Be at least 10 lb. and gaining weight.

2. The hæmoglobin must be at least 80 per cent.

3. Be free from all forms of infection, especially upper respiratory infection.

4. The temperature must be normal.

Unless a child can fulfil the above criteria, surgery must be postponed until a later date when they can be fulfilled. It is also important that the operation of lip or palatal closure should not extend beyond one hour from the time of anæsthetic induction to recovery.

With the completion of successful palatal surgery the child has palatopharyngeal closure and a reasonable soft palate with which to develop speech.

Speech—the power of human beings to intercommunicate—is one of the most important

faculties we possess over our primate ancestors, while language is one of the highest manifestations of human intelligence: remove it and our intellectual powers are greatly impoverished.

Speech itself is a most complicated and highly organized faculty, and a fault in one

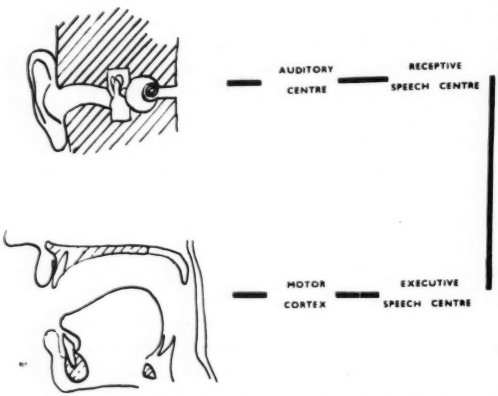


Fig. 5.—Diagram of the main links in the chain of speech. *Above*, The receptive phase. *Below*, The executive phase. A failure in any link in this complicated chain may affect normal speech.

link in the chain of speech can render the person unintelligible.

It is convenient to divide speech into two phases:—

(1) The receptive phase; (2) The executive phase (*Fig.* 5).

The *receptive phase* covers all the processes involved from hearing at the external auditory meatus to the receptive speech centre in the cerebral cortex, and includes transmission of the sound through the middle and inner ear; the nerve impulses pass via the auditory nerve through the auditory centre to the receptive speech centre.

The *executive side* is from the executive speech centre (which initiates the reply and transmits it via the motor cortex) to the muscles responsible for speech—namely, lips, cheeks, soft palate, pharynx, tongue, etc. Added to all this there must be a reasonable intelligence to carry out and co-ordinate this intricate process.

It is not generally realized that the pattern of speech is formed at a very early age. At 1 year a child has a vocabulary of 10 words, at 18 months it has 20 words, and at 2 years it has 200 words, so that it is quite obvious that in order to avoid unusual and atypical muscle habits in speech the soft palate must be united as soon as possible. It is therefore probable that the earlier these tissues are restored to their normal position and function the greater their recuperative powers.

Now, in cleft children we may have one or more weaknesses or even failure in the chain of speech, e.g.:—

1. Deafness is more common than usual.
2. Soft palate may be short, allowing nasal escape (rhinolalia).
3. Soft palate muscles may be defective in function and co-ordination, producing movements too slow for proper speech.
4. Tongue posture and movements may be detrimental to normal speech.
5. Hard palate may have a fistula into the nasal cavity.
6. Maxillary arch may be collapsed, preventing normal tongue movements.
7. Lips may be tight, short, or immobile.
8. Nasal cavity may be reduced in size by maxillary collapse.
9. Intelligence may be subnormal.
10. Personality may be adverse to good speech.
11. Parents' over-anxiety to help may also be detrimental to good speech.

It is obvious that the problems confronting the speech therapist are complicated and obscure and all assistance possible must be given to this member of the cleft-palate team. The therapy is usually started at about 4 years of age, but intelligent parents can give valuable assistance before, during, and after speech therapy: and although considerable improvement can be achieved it must be realized that many will never attain normal speech and some will always be unintelligible.

Dental Treatment.—There is a tendency among the dental profession to avoid the routine treatment of these unfortunate children. This appears to arise from a combination of fear, awe, and repulsion. They feel

they are not capable of carrying out treatment and that it should be done at special centres. This should not be the case. The child should be treated as a normal member of the family and visit the family dental surgeon three times a year with the rest of the family. It is important that they should not feel different from their brothers and sisters.

Treatment itself should start by visits at about 3 years of age. Treatment should be

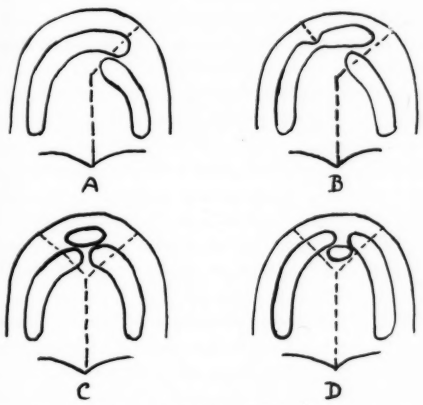


Fig. 6.—Collapse of the maxillary segments in unilateral and bilateral clefts of lip alveolus and palate following surgical restoration of the circumoral musculature. A and B, Unilateral cleft of left side: note collapse of lesser maxillary segment and its overlapping by the larger segment. C, Bilateral collapse of both maxillary segments, excluding the premaxillary segment from the arch. D, The premaxillary segment is overlapped by the maxillary segments. When the premaxillary segment is wedged between the two maxillary segments little collapse of the arch can occur.

very limited, but instruction in oral hygiene is most essential. The services of an oral hygienist is the ideal, but is not always available.

All deciduous teeth must be saved wherever possible, but simple treatment is to be recommended while long, tedious, and possibly painful procedures should be avoided. The extraction of carious deciduous teeth should not be undertaken unless they interfere with sleeping and eating.

The conservation of the permanent dentition is of paramount importance and only the best possible work should be done. The loss of the permanent teeth in cleft-lip and palate patients can produce tragic results in later years when the problems of prosthesis stability become evident.

Tissue Deficiency.—When considering orthodontic problems it must be remembered that in clefts there is a deficiency of tissue and that tissue is considered to be mesoderm. Stark (1945), in his work of cleft embryos, showed the absence of mesoderm and he suggested that clefts were due to lack of mesodermal penetration. The amount of this lack determines the severity of the cleft and may vary from a slight notch in the vermilion border of the lip to a complete bilateral cleft of the lip and palate.

It must also be realized that clefts of lip only and clefts of palate only do not present any real problems to the orthodontist. When, however, the lack of mesodermal penetration is present in lip, palate, and alveolar process, orthodontic and dental orthopædic treatment is invariably necessary. In unilateral and bilateral clefts of lip and palate there is a break in the continuity of the maxillary dental arch dividing the maxilla into two or three segments. Once the lip is surgically united the restored muscle function exerts considerable pressure on this defective arch, with the resulting collapse. The degree of collapse varies from case to case, but is closely associated with the amount of tissue missing (*Fig.* 6).

It must be emphasized that this maxillary collapse is not caused by modern palatal surgery, nor is it influenced by the time at which the surgery is carried out. Multiple palatal surgery carried out by surgeons untrained in modern plastic technique can cause irreparable damage, but these cases are fortunately very rare to-day.

Orthodontics.—This treatment should be divided into: (1) Dental orthopædics; (2) True orthodontics. The object of these treatments is: (*a*) Dental orthopædics aims at restoring the maxillary segments to their normal position, thus obtaining normal articulation with the mandible. (*b*) Orthodontic treatment is confined to individual tooth movement.

Dental orthopædic treatment encourages:—

a. Normal dental function during chewing.

b. Normal muscle movements during speaking, swallowing, etc.

c. Self-cleansing of teeth and lack of caries.

d. Normal nasal dimensions assisting speech and respiration.

e. Normal facial contour.

f. Improves position of collapsed alar base, helping nose shape.

g. With alinement of the maxilla to reasonable normal position, normal environmental factors combined with genetic growth potential will assist to give maximum growth and provide accommodation for the erupting permanent dentition.

Orthodontic Treatment.—Is directed to correction of individual teeth to help æsthetic harmony and normal function and to give arch stability.

It must be realized that the orthodontic problem associated with cleft children may be further complicated by the superimposition of malocclusions which we see in everyday orthodontic practice.

Timing.—Dental orthopædics should be carried out as early as possible, but should be delayed until full co-operation of the patient can be ensured. The age of 4–6 years is the ideal, but if the necessary co-operation is not forthcoming treatment must be delayed until the mixed dentition.

The dental orthopædic treatment repositions the maxillary segments into normal relationships with the mandible and cranial base. This involves swinging the segments outwards against the contraction of the facial muscles. The fulcrum is the craniofacial sutures system of the maxilla, especially the zygomaticomaxillary and pterygopalatine suture systems. It is interesting to note that in most cleft cases the first permanent molars are usually in normal occlusion with the mandible while the pharyngeal width from side to side is greater than normal.

Dental orthopædic treatment should not be started until rapid success is ensured. Maxillary repositioning is usually carried out by movable or fixed appliances and active treatment should take 6–12 months only.

This must be followed by retention of the segments until the permanent dentition is established. Movable appliances, multiband appliances, and silver cap splints are all used. These appliances vary considerably, but great success has been achieved by double-C spring appliances or silver cap splints with single or double-C springs. (Kettle, 1952; Walther, 1954; Glass, 1958.)

The great advantage of the removable double-C spring is that it is simple to construct, easy to adjust, and, most important of all, by closing any anterior palatine fistula is of great help in speech and deglutition.

Orthodontic treatment is usually carried out during the mixed dentition. The treatment is essentially tooth movement and the usual principles of everyday orthodontics apply. The first and most important work is the establishment of an anterior overbite to give a stable incisor relationship and to support the labial segment. This may be followed by a period of retention until the premolars and canines erupt, after which further tooth alinement may be necessary.

This treatment is best carried out by fixed appliances followed by retention. In the majority of this type of cleft case there is malformation or absence of one or more incisor teeth, so that the retention appliance must include the missing tooth or teeth as a prosthesis.

The retention appliance carrying any missing incisor tooth and closing any nasopalatal fistula must always be worn and must eventually be replaced by a metal prosthesis or some form of tooth-bearing bridge to retain space. Loss of this appliance produces immediate and rapid collapse of the maxillary segments, with the corresponding disfigurement, and a reserve retention appliance is a wise precaution greatly appreciated by the patient.

Final Surgery.—Final plastic surgery to the lip and nose is usually delayed until the child has reached at least 14 years of age. Experience has shown that any surgical interference to the nose before this age may cause irreparable damage to the growth potential of the nose, producing a stunted and poor-shaped nose of childish dimensions in an adult face.

Prosthetics.—Most unilateral and bilateral clefts of lip and palate will need a prosthetic appliance to retain the maxillary segments in their correct position. These deficiencies can be supplied by a bridge or by a small prosthesis.

In modern cleft-palate planning, speech is given the highest priority with function; to this end the soft palate is retropositioned to give palatopharyngeal closure, if necessary at the expense of the tissues of the hard palate. An oronasal fistula in the anterior part of the hard palate is therefore often seen. This presents little or no prosthetic problem to close, but can be difficult to close surgically.

It is therefore usual to fulfil the necessary requirement by a temporary prosthesis, which can be replaced when the dentition has matured by a small metal prosthesis having as little contact with the teeth as possible.

Where a palatal fistula exists in a normal dental arch, or where the arch has been restored by a bridge, it can be closed by a small bung of soft acrylic supported on a palatal plate which has no contact with the teeth.

True, obturators are occasionally necessary, but they usually indicate that the overall tissue deficiency is too great for normal methods of repair or that the treatment plan has failed.

It is encouraging that obturators filling large clefts in soft palates are much rarer to-day than twenty years ago, and it is hoped that with time they will become a greater rarity.

Oral Surgery.—Many of the severe clefts, especially bilateral clefts of lip and palate in which the premaxilla has been removed, display a very pronounced mandibular prognathism which is caused by a large mandible articulating with a very deficient and even agenetic maxilla. This discrepancy of size is further enhanced by a forward posturing of the mandible, while the tight and short upper lip is assisted in lip closure by a large and protruding lower lip.

Bilateral mandibular resection to reduce the prognathism gives very pleasing results and lasting gratification from the patient.

In adult cases where the soft palate has not been closed and an obturator is worn, the loss of the maxillary teeth acting as a prosthetic anchorage is a persistent nightmare to these patients. They well know the problems of retention of the prosthesis when all teeth are lost. New techniques of metallic implants (Ward, unpublished) have opened up fields of great importance to these orofacial cripples and they need not be so concerned about prosthetic problems in later years.

INCIDENCE

As has been previously stated, the annual incidence of clefts of lip and palate and isolated cleft palate exceeds 1–1000 live births. This is a high figure, especially when one considers that the incidence is ten times greater than the chance of winning a prize in the Premium Bonds.

Analysis of 650 cases attending the Plastic Centre at East Grinstead shows some interesting facts in the distribution of different types of cleft and in the sex difference.

It must be noted that the cases represent those clefts which seek treatment at a special centre and will differ somewhat from an analysis of clefts of newborn children. Whereas the sample here analysed will not include minor clefts of soft palate which need no treatment, nor those people with cleft of lip and palate who do not desire any surgical treatment, the sample of the newborn will not include the many minor clefts of soft palate and certainly not the submucous clefts or hard and soft palate which may not become evident until normal speech fails to develop properly at 2–3 years of age.

Table I shows that:—

1. Cleft lip and palate is twice as common as cleft palate.

2. Cleft lip and palate is almost twice as common in males as in females.

3. Isolated cleft palate is more common in females than in males.

4. Unilateral cleft of lip and palate is twice as common on the left side as on the right.

Table II shows that:—

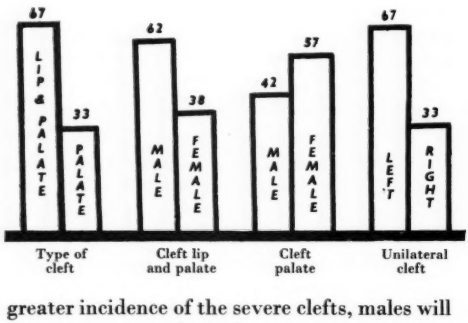
5. Left unilateral, right unilateral, and bilateral clefts are much more common in males than in females.

6. In the total of all types of cleft there is a greater occurrence in males than in females.

In view of the sex distribution of clefts it is evident that there will be more males in need of treatment than females, and in view of the greater incidence of the severe clefts, males will require more prolonged treatment with less successful results.

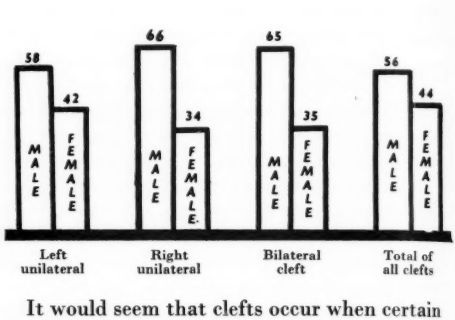
All severe clefts involving the alveolar process will need special extensive dental orthopædic treatment. This number will represent at least two-thirds of all cleft cases or an annual birth-rate of about 500 such cases.

Table I.



It is now recognized that there are two main causative factors in cleft lip and palate—a genetic and non-genetic extrinsic factor—and that cleft lip and palate and isolated cleft palate are genetically different (Glass, 1955).

Table II.



It would seem that clefts occur when certain environmental factors act on a susceptible genotype, and, although many of the non-genetic factors are known, the problem of identifying the gene or genes responsible is unsolved.

The analysis of the gene chemistry and the study of the structure of desoxyribonucleic acid may eventually lead to the identification of the defective D.N.A. molecule which produces the abnormal enzyme, manifest as a developmental abnormality.

Thus susceptible genotypes may be distinguished from normal and selective mating encouraged.

With the recent advances in the treatment of clefts the rehabilitation of the defective child is greatly facilitated and the results so improved that many are now more likely to marry.

Table III.

Parents	First Child	Second Child	Incidence	
			Cleft Lip and Palate	Cleft Palate
1. Normal	Cleft defect	Sibling chance	1 : 25	1 : 71
2. Cleft one parent affected		Offspring chance	1 : 50	1 : 14
3. Cleft one parent affected	Same cleft	Sibling chance	1 : 7	1 : 6

GENETIC COUNSELLING

It is the duty of all concerned with the treatment of congenital deformities to be able to advise on the incidence of these deformities.

If a couple are contemplating marriage and one has a cleft or has a family history of a cleft, then both partners should be made fully aware of the risk they run in perpetuating this defect, so that they can either avoid marriage altogether or certainly avoid reproduction if they think that the risk is too great.

With modern communal treatment at special centres there is a great likelihood of marriage between cleft partners. This immediately presents considerable problems from a national point of view and it is probable that there will be a small increase in the incidence of clefts. This would not be immediately apparent but might be evident over a period of several generations (Fogh-Anderson, 1942).

Table III, taken from Fogh-Anderson's work, is a guide to genetic counselling.

The above table gives a good guide as to the incidence of these cleft deformities and is useful in advising parents. Certain features arise which are of importance:—

1. With normal parents and a cleft first child the chances of a sibling being cleft is three times as great if the defect is cleft lip and palate compared with isolated cleft palate.

2. If one of the parents has a cleft then the chances of the first child having a cleft is three times as great if the defect is isolated cleft palate.

3. If one of the parents has a cleft and the first child has a similar deformity then the chances in siblings is high for both cleft lip and palate. The latter (1 : 6) is extremely high.

4. If one of the parents has a cleft lip and palate and the first child has an isolated cleft palate the chances of the siblings is not increased above the figures for *Table III*.

5. If the father has a cleft lip and palate and the mother has an isolated cleft palate the incidence is not increased for the children above the figures for *Table III*.

It is also evident that females will be able to hide their defects easier than males, are more likely to marry, and thus are more likely to pass on the defect to the next generation.

So far we have considered the physical defects associated with cleft of lip and palate. There remain the mental and psychological problems confronting these orofacial cripples.

Facial disfigurement combined with defective speech attracts the attention of all. Children of the same age ridicule and draw attention to these defects in a cruel manner. The defective child knows he is inferior to his playmates, and this perpetual ridicule creates a depressed and inferior outlook to life. The end-result is lack of self-confidence which creates in time a maladjustment to his surroundings and to society in general. This tends either to produce a recluse or to swing the other way and produce delinquency.

Many parents succeed in bringing up the child in a reasonable manner, but the attitude of some parents, however, is often one of two extremes: They either form a protective screen around their defective offspring to such an extent that the child does very little for itself and when adulthood is reached it is incapable of looking after itself; or the parents, realizing that they have produced a defective child, with the associated social stigma, want to have nothing to do with it and neglect it whenever possible.

All these problems and many others confront the cleft lip and palate patients and his parents. Great misery and suffering is evident, but with modern methods of treatment and better social rehabilitation, the lot of the orofacial cripple is not as grim as it used to be.

SUMMARY

To-day the treatment of cleft children is carried out in a special centre where the various aspects of treatment are planned by the expert concerned. The secret of success depends on early treatment planning and co-ordination of the various aspects of treatment, which must be an integral part of the long-term process of rehabilitation.

With modern techniques and the early analysis of successful and unsuccessful results the future of the orofacial cripple is greatly improved. The incidence of these cleft deformities, however, may tend to increase, and the chance of perpetuating any such defect should be fully understood by a susceptible genotype contemplating marriage.

I would like to express my appreciation for all the help I have received in connexion with this paper from the members of the Cleft Lip and Palate team at Queen Victoria Hospital, East Grinstead, and especially to Mr. Gordon Clementson and his Department for the slides and photographs.

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DISCUSSION

The President thanked Mr. Glass for giving a most interesting talk on a very important problem. He was glad that the author had spent some time stressing the humanitarian aspect.

Mr. Walther: First, I would like to thank Mr. Glass for his paper illustrated by most excellent slides.

I liked his section on Presurgical Dental Orthopædics, with its note of warning that this may not be the complete answer to our problems. It seems to me to be extremely useful in the bilateral cases, but I would suggest caution in the unilateral ones. Here I would like to see it used in only 50 per cent of cases, and the others observed carefully as controls. It is extremely popular with the surgeons because it makes the surgery easier. Provided it makes the surgery more efficient and limits the field of surgical interference, it may be a tremendous advance despite the fear of swinging backwards the larger segment, and thus accentuating the Skeletal III dental base tendency. Time will tell, and I suppose it will be 10–15 years before we know the answer. I would like to hear Mr. Glass's views on this.

As regards the time of operation for the lip, I agree with him that it should be as early as possible—in fact as soon as the baby is fit enough for it. I disagree with him, however, concerning the time of the palate operation. This, I feel, should be delayed until after 2½ years of age, or even later. As he very rightly says, speech is very important and it is mainly speech and the parents' insistence that something should be done that have determined the very early age of operation. At the Hospital for Sick Children, Great Ormond Street, we have operated on a large number of cases after the age of 2½ years, and their speech is certainly no worse for it. On half of these cases we fitted metal cap splints before operation, in order to prevent any collapse due to scar-tissue contraction, etc. This splint was divided about 3 months after operation and the smaller segment swung out with a palatal element and then retained. I would like to know whether Mr. Glass has had any experience of this type of treatment. The main snag, as I see it, is this question of having to begin retention so early. I thought he was being very dogmatic when he said, "It must be emphasized that this maxillary collapse is not caused by modern palatal surgery, nor is it influenced by the time at which the surgery is carried out."

My own experience is that even the best surgery has some effect, maybe only slight, quite apart from the other factors, and this will be less if the operation is carried out rather later.

I also feel that the prognosis of a case not only depends on the severity of the cleft, but also on the inherited skeletal pattern that is present before the cleft deformity has been added.

It is interesting how comparatively uncommon it is to find the parents with a Skeletal II dental base, and yet this Skeletal II base relationship is quite common statistically in a cross-section of the community.

As regards treatment, I was interested in his division into:—

a. Dental orthopædics: To be done as early as possible, i.e., 4–6 years of age. *b.* Orthodontic treatment: Usually done in the mixed dentition.

Personally, I like to group these together and swing out the collapsed segment much later, when I am beginning the other orthodontic treatment, unless I have to retain the case for some other reason. I think the incisor relationship should be corrected fairly early, as this does not require long retention. Then I find that it is usually best to leave the main treatment until the deciduous teeth are all shed. I do not feel that his early dental orthopædic treatment does all that he claims by beginning it early and retaining.

He says that "The first and most important work is the establishment of an anterior overbite to give a stable incisor relationship and to support the labial segment." I agree with this, but I must say that I find it very difficult, in fact usually almost impossible, to treat an anterior open bite in these cases. This seems to become worse with age, and, personally, I can usually only improve it very slightly. I would like to have his views on this.

I agree with him that fixed appliances are not only best but essential if much orthodontic treatment of cleft palate cases is done.

He mentions the question of the oronasal fistula that sometimes develops after operation. I wonder whether it is worth risking this in order to get palatopharyngeal closure. I would like to ask him, "Is this so terribly important for speech?" And has he had any success in closing this fistula with palatal ticklers?

Finally, I am glad that he went into the question of incidence and genetics more fully. It is so important to be able to discuss this with the individuals concerned. As he so rightly says, this deformity is likely to become much more common. I wonder how he proposes to encourage selective mating?

Once again, I would like to thank Mr. Glass for his most enjoyable paper.

Mr. Glass thanked Mr. Walther for volunteering to discuss the paper. Words of wisdom from Mr. Walther

were worth listening to, for he had had a lot of experience in cleft-palate work and his suggestions and disagreements were to be welcomed. After all, orthodontic treatment of these children was still more or less in embryo, and although the work done at different centres might not be strictly comparable, there was something to be learnt from disagreement and argument.

Mr. Glass said he would not be able to answer all the questions asked by the opener because there was not time and, in any event, he did not know all the answers. He could not agree to palatal closure at 2½ years. The child had a speech mechanism at the end of 1 year, and at the end of 2 years words were being formed into sentences. Again Mr. Glass considered that it was wrong to leave a palate open until the age of 5 in order to allow the maxilla to grow. The question of surgical splints was interesting. It would be interesting to see what came out of the work that was being done in this field.

It did not seem as if open bites could be closed, especially in cleft-palate children. As regards the palatal fistula, the soft palate must be closed at the expense of the hard palate. The object was to get the soft palate as far back as possible to obtain palatopharyngeal closure. Mr. Glass explained that although he had used, and was still using, stimulators, he was not entirely convinced of their effectiveness. And the covering of a hard palate fistula was the same prosthetic problem whether the fistula was large or small.

As far as selective mating was concerned, the subject might involve some difficult problems, but undoubtedly it would come. It was done in the first place with animals. All good husbandry was connected with selective mating: no one would think of running a farm without it.

There was no reason why the human race should not do something similar. The arrangement of the bases in the chromosome determined the future of the human being. In the case of a misplacement of a base the result was a congenital deformity and there would be defective cell action. In certain congenital deformities it had been possible to label the gene bases. They had been analysed by "chromosome" fingerprints. In time it might be possible to analyse chromosome fingerprints and forecast that a person had a predisposition to a congenital deformity. If it is illegal for a person to marry a first cousin, presumably there was no reason why it should not be made illegal for one cleft palate to marry another.

Professor C. F. Ballard congratulated the author upon his summary of the problems. They should not at the moment take what was known to be the speech therapist's view, that their speech patterns were laid down. The late Professor Willis had made that point when saying that there was more than failure of normal musculature in these cases.

It was suggested that deciduous teeth broken down should be left at all costs—surely that view was incorrect. Anybody attached to a children's hospital would know that fairly frequently children were admitted who were unwell and running a temperature and it was only as a last resort that the dentist was consulted, and it was then found that apical infection was present. Such infection should not be left in a child's mouth.

The President said that he agreed very much with Professor Ballard. He liked to eradicate sepsis and found it useful to be able to have a competent anæsthetist and to get quite a lot of conservative work done at the same time.

In answer to Professor Ballard, *Mr. Glass* agreed that the problems of speech were very complex and that muscle function formed only a part of the mechanism. Many unoperated cleft-palate cases spoke better than some whose palate was closed and whose palatopharyngeal movements appeared normal. The I.Q. of the patient was one of the most important factors.

Professor Ballard, Mr. Oliver, and the President had all brought up the question of the extraction of broken-down deciduous teeth. Mr. Glass considered that the answer had many facets, partly theoretically and partly practical. First of all it has never been scientifically proved that broken-down deciduous teeth always produce the symptoms claimed by Professor Ballard. There were probably millions of broken-down deciduous teeth in the children's mouths of England which were causing no detectable harm and would be normally exfoliated in due course. If sepsis exists in the mouth it is open sepsis and relatively harmless. The real danger was the closed sepsis of the conserved tooth, with the only outlet being into the blood-stream.

From a practical point of view Mr. Glass would like to ask where the dental manpower necessary to carry out the suggested extraction of these teeth was to come from. And, finally, was it correct to subject these children to the mental and physical trauma of multiple gas extractions with the ensuing loss in confidence of the patient? Mr. Glass thought not, and repeated that only when these teeth interfered with eating and sleeping should they be removed, and should it be necessary to remove an offending tooth then all others of a doubtful character could be removed at the same time.

Mr. D. H. Oliver said he would like to support Professor Ballard up to the hilt. There were far too many doctors and dentists who were sadly unaware of the effects of sepsis from primary teeth—he preferred to call them 'primary' teeth rather than 'deciduous' teeth. The author had shown them a picture of a naval rating when describing what were called "overdentures". It was not stated that the naval rating had any treatment at all for what were quite obviously infected teeth, to which an overdenture was applied.

In reply to Mr. Oliver, *Mr. Glass* said that the merchant seaman had never had extensive routine treatment, and certainly no orthodontic treatment. He refused extensive conservative treatment but did permit the silver nitrating of all exposed dentine.

The teeth although broken down show no apical infection and in fact were nearly all vital despite the appearance. An overdenture was therefore the only answer to this patient's problems.

Mr. A. F. Dee Shapland thanked the author for a most interesting paper. There had recently been one or two cases in Exeter where unilateral cleft was associated with obstruction to breathing by the tongue. The dental surgeon concerned, Mr. W. Selley, fixed a palate into a very young child (a week old) and immediately stopped the trouble. There was a great psychological effect upon the parent because she was able to feed the child. Could such a small palate, attached by two wings to the cheek by adhesive tape, be used as a method of dental orthopædics, and would the author advise it? If so, how and at what age?

In reply to Mr. Shapland, *Mr. Glass* considered that the tongue obstruction was not common except in cases of micrognathia associated with a cleft. The fitting of a small sucking-plate was very beneficial in these cases, and if movement of the maxillary segments was necessary the plate could be constructed to carry this out. The ideal age was as soon after birth as possible. Interesting work

of this kind was being done by Dr. Burton and his team at Liverpool.

Mr. J. C. Ritchie said that the figures of East Grinstead showed there were two chances to one of a cleft occurring on the left-hand side. The world figures showed a proportion nearer to three to one. He had given much thought as to why that should be and had had an opportunity of discussing the question with embryologists in various places. The most satisfactory explanation seemed to be that in embryo the left-hand side of the face formed approximately thirty-six to forty-eight hours ahead of the right-hand side, and if there was a predisposition to cleft, then it was feasible to suppose that it might start on the side of the face which formed first.

On the question of shortage of tissue, one could not be sure that it was fair to assume such a shortage. At about the seventh week of intra-uterine life, it was known that the palatal processes approached one another and finally fused, once the tongue had taken up a more ventral position. As soon as this fusion had taken place there was, in the normal embryo, a considerable lateral expansion or stretching of the tissues forming the palate.

In the case of the cleft, however, if this critical period of fusion was passed, without union, then the lateral expansion of the palate took place in a modified form, without any stretching of the tissues. In other words, once this crisis of palatal fusion had passed, there was then no other opportunity of the palatal tissues to come together.

Would Mr. Glass express his views on those particular points?

Mr. Glass: Mr. Ritchie brought up the question of incidence of left- and right-sided unilateral clefts. The world figure of three left to one right was considerably greater than the East Grinstead figures, but in view of the fact that the 2 to 1 proportion was the same as Dr. Fogh-Anderson's Danish study, the difference in these figures might be due to racial differences.

With regard to the tissue shortage the lack of mesodermal penetration referred mainly to the formation of the lip and primary palate. The process of palatal cleft formation was probably different, it certainly occurred much later and had a different genetic background.

Mr. Glass could not agree that in normal lip formation there was any fusion of processes after epithelial tissue breakdown. He considered that the normal process of lip formation took place by a bulging process of the invading mesoderm, which was followed by angiogenesis. It was angiogenic failure which was probably the cause of the cleft.

With regard to the cleft palate and growth, Mr. Glass considered that after the initial failure resulting in a cleft, all tissues grew and developed normally. Any increase in the cleft size was exactly relative to the increase in size of the surrounding tissues.

Mr. M. A. Kettle felt they should be very grateful indeed to Mr. Glass for bringing his customary gale of fresh air on to the whole subject. As to the timing of operations he himself had been comparing results of lip operations over many years, the performance of the operations having varied from some hours after birth to some years after birth. There was no doubt that the nearer the operation was to birth the greater the deformity in the upper arch. The ideal would seem to be to leave the operation for as long as it could be left, and that was not usually for more than six months. Conversely, the palate operation was better for being performed early. The principle was that the sooner the child had the mechanism to speak (if possible, well before speech started), the better would be the quality of the speech. The approach now was to try to encourage the upper arch to go forward. That movement in itself produced a certain amount of overlapping, as it were, of the upper arch over the lower; and the final movements that were required, not in the temporary dentition but in the permanent one, were not those that required an overall expanding movement.

Mr. Glass welcomed Mr. Kettle's answering remarks. It was essential to maintain a sense of humour when talking orthodontics, and still more essential in this tragic side of our speciality.

He noted that Mr. Kettle was also in favour of early palatal closure, especially before the speech pattern was forming. Mr. Glass considered that the restoration of speech to as near normal as possible is the most important feature of the rehabilitation programme.

With regard to the time of lip closure, and the degree of maxillary deformity, Mr. Glass could not agree that early lip closure always caused greater maxillary collapse —differences in surgical techniques, timing, etc., superimposed on differences in each cleft, made a strict comparison almost impossible.

The problem of repositioning of the maxillary segments involved forward and lateral expansion, the object being to restore as nearly as possible the collapsed segments to the position they would occupy if there was no cleft.

The President said that he appreciated that the discussion could well be continued for some time, but in fairness to the authors of other papers he must draw the discussion to a close.

Heredity and the Craniofacial Complex

Six sets of same-sex triplets were examined with cephalometric radiographs to test the genetic determination of the craniofacial complex. In examining comparatively complex combinations, such as the cranial vault, a positive correlation with zygosity could not be found. A comparison of the morphology of individual bones was made by attempting to superimpose the single bone profile tracings of monovular and diovular pairs. Almost perfect concordance characterized monovular triplets and there was a lower degree of concordance in diovular triplets. It is suggested that the morphologic aspects of single bones could be used as a factor for determining zygosity with the same degree of reliability as blood groups, etc.—KRAUS, B. S., WISE, W. J., and FREI, R. H. (1959), *Amer. J. Orthodont.*, **45**, 172.